THE INDEPENDENT GUIDE TO IBM PERSONAL COMPUTERS

PC

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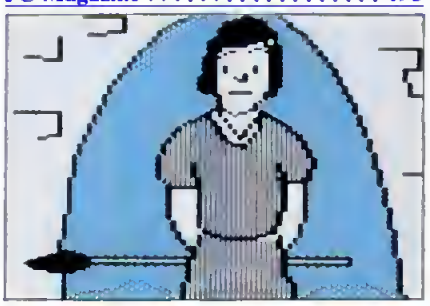

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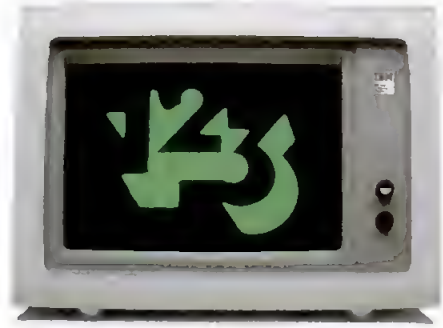

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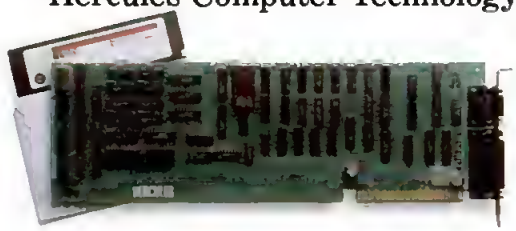

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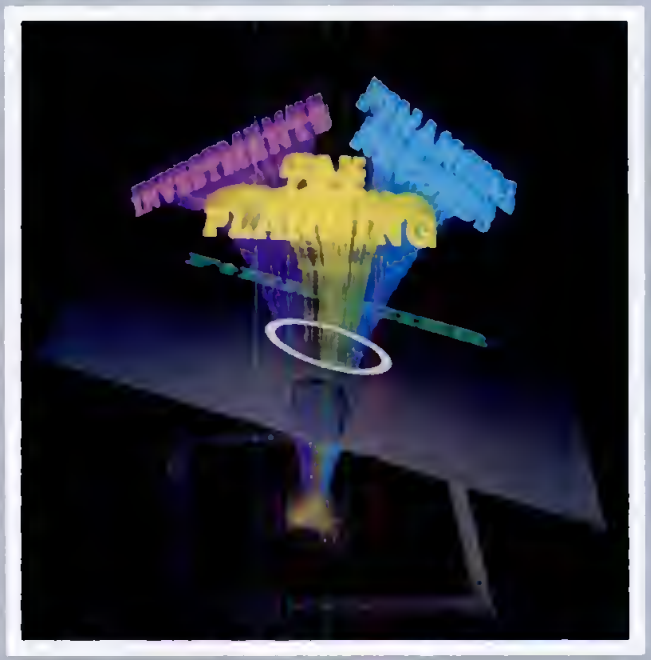

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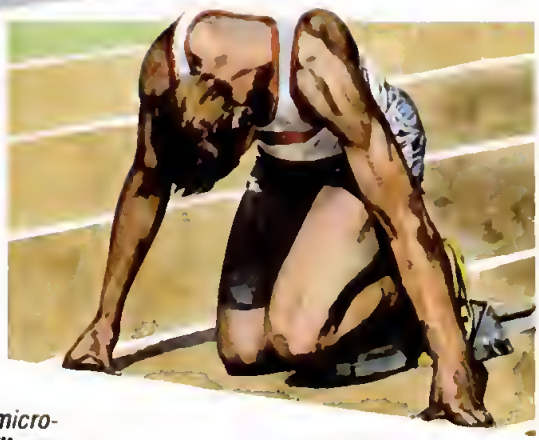

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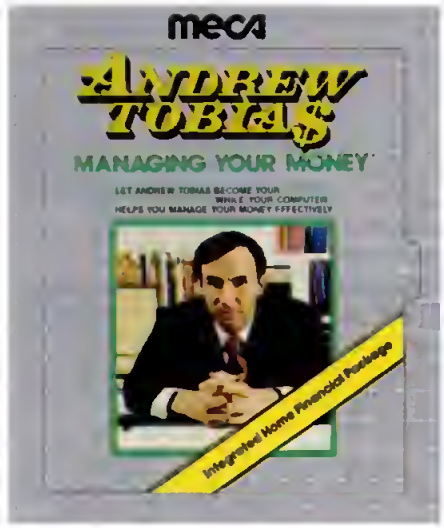

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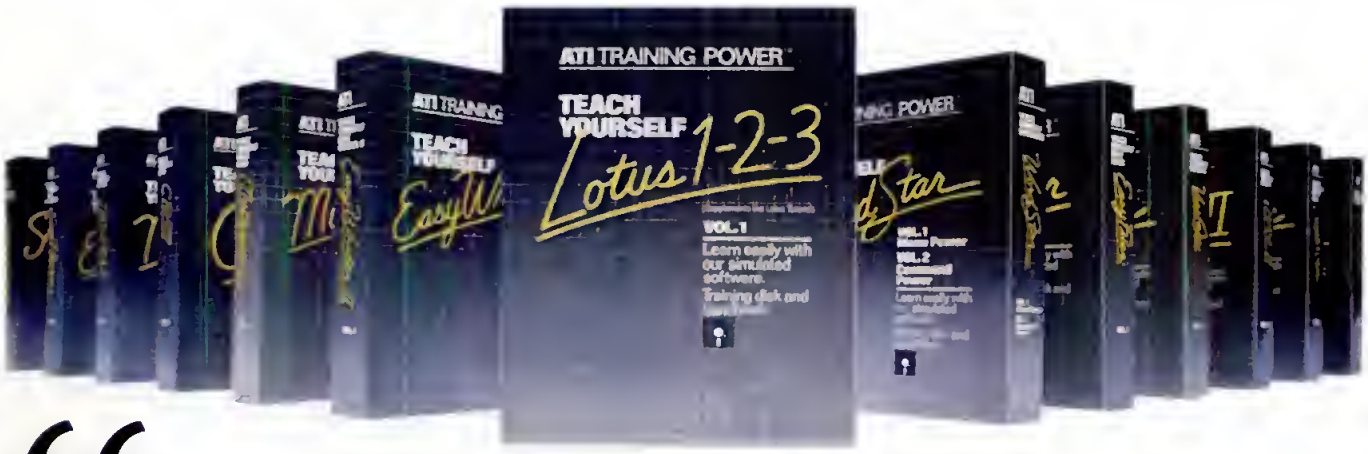

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CIRCLE 117 ON READER SERVICE CARD

What's Inside

PC's C-team deserves an "A" for its hard work on this issue's cover package, which examines the current uses and potential of the powerful new programming language, C.

Leslie Baker and Nat Sakowski are a husband-and-wife free-lance writing team that is crazy about the C computer language. So, it was not surprising that one of the first article ideas they suggested 6 months ago to *PC*'s then newly installed executive editors was an introduction to this powerful, portable new tool for programming PCs. Little did they know at the time that their article would burgeon into a major section of the magazine.

At first, executive editor Mike Edelhart thought that C could be covered in a single article; a brief, breezy first look at this language that is moving from professional programmers' shelves into the homes and offices of PC users. But, when he saw Baker and Sakowski's first rendering of the story, he knew immediately that he had underestimated the importance of, and inherent interest in C. So, Baker and Sakowski were called into the magazine and told that their article—which followed their original instructions rather well—was simply not acceptable. As their punishment, they were asked to make it three times longer.

Baker and Sakowski set to work creating a piece that went far beyond their original introductory work. When they staggered into *PC*'s office with a major opus some 40 pages long—the ultimate C article—the editors were pleased and began talking about putting C on *PC*'s cover.

Then, as Baker and Sakowski were about to heave a well-earned sigh of relief, editor Bill Machrone got an evil gleam in his eye and opined that no C article package could be complete without reviews of the several C compilers that have recently become available for the PC.

A bit shellshocked, Baker and Sakowski charged once more into the breach, this time to review the Lattice C compiler. In an uncharacteristic moment of mercy, *PC* editors brought in contributing editor Mark Zachmann (another C aficionado) to review Mark Williams's C compiler and the Digital Research compiler which, sad to say, never got into his hands.

Just as this hubbub was going on over C, Stephanie Stallings gave up a perfectly good consulting business to join *PC* as a staff editor. Barely had she gotten her coat off when the entire C section was tossed her way with firm instructions that it be edited, checked, zipped up, and blessed before the next full moon. Not only did she get everything done, she added her own bit to the C package—an interview with C maven Tom Plum—and also wrote an in-depth review of PC program editors.

Meanwhile, in the art department, art directors Mitch Shostak and Mary Zisk were wrestling with the question of how to illustrate something as amorphous as a computer language. For hours they questioned editors for clues. C is a programmer's tool chest, filled with specialized utensils for accomplishing specific programming tasks. Would a tool box picture work? On the other hand, C is powerful and fast. What about the Road Runner? A snazzy car? Too confusing.

What did we decide? You get to see the results of our wrangles on the cover and throughout the C feature package.

We'd like to offer special kudos to the members of our C-team. They worked through the holiday season under fiendishly tight deadlines and produced a superb, detailed report on this important new possibility in PCing. For their work on C, they all deserve an "A." ■

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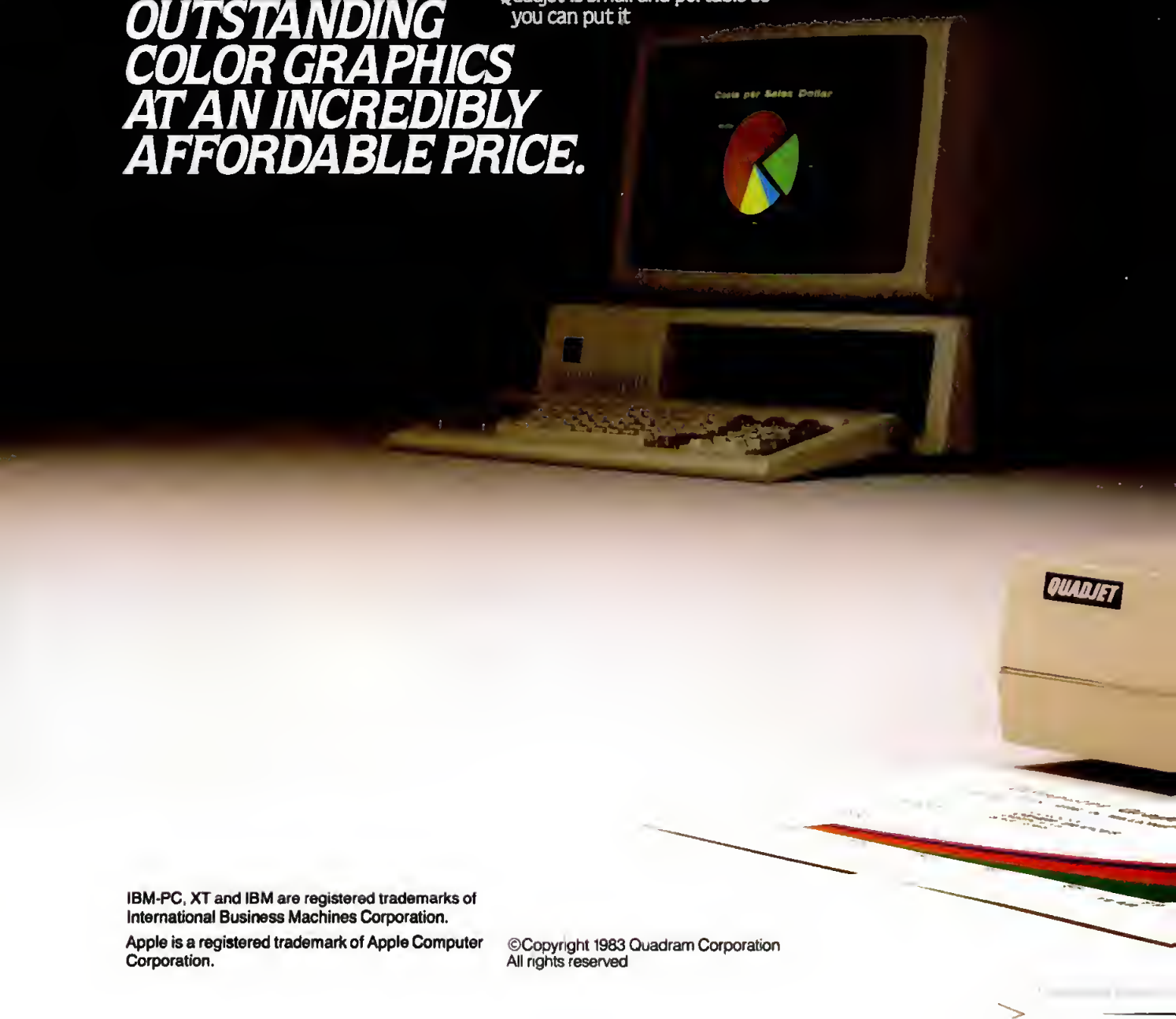

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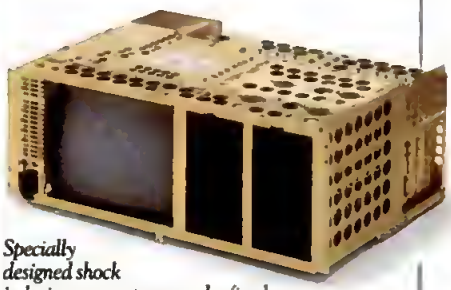

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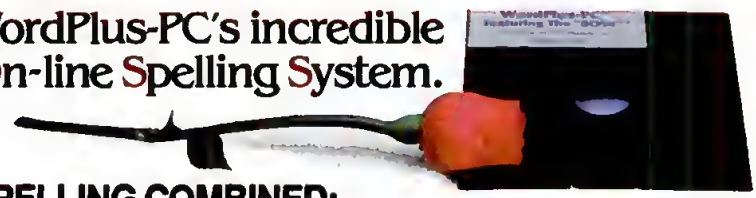

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5-1/4" double-side, double-density, soft sector	IBM PC (dual side)	54624	3.50	54980	3.74	MD550-01-18188	4.10
8" single-side, single-density, soft sector IBM Format 2305830	Radio Shack TRS-80 Model I	53428	2.55	54998	3.06	FD34-1000-3718	2.66
8" single-side, double-density, soft sector	Radio Shack TRS-80 Model II			54021	3.23	FD34-8000-18137	3.40

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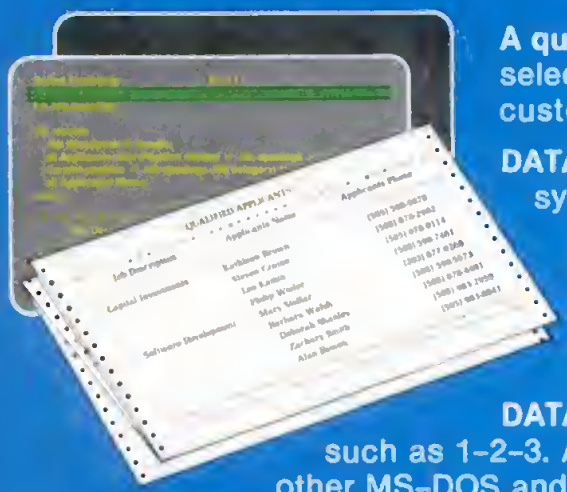

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The Juki 6100: A daisy wheel printer with proportional spacing at an unheard of price.

The Juki 6100 has a lot of style to make you look your best. Handsome letter-quality typing and even proportional spacing for your correspondence and presentations. Stylish, perfect, page-by-page typing ready for binding. Slick and professional.

Yet we are offering the Juki 6100 for only $499. This new printer has caught on so well that we can lower the price to a level never imagined for letter-quality printers! It's an unbeatable value. Take the time to read this ad, and we'll prove it to you.

Top performance letter-quality printers have always been expensive. And the lower priced attempts have proved clumsy, noisy, and slo-o-o-w. And don't be fooled by "correspondence quality" claims for matrix printers: there is no way around the fact that they produce characters from dot patterns. Letters and reports just don't look, well, *typed*. If you want fully-formed characters, and a true typewritten look, there is no shortcut.

Now comes the perfect combination: a low-cost, truly letter-quality printer, with a housing that makes it look much more costly—and it is even fast!

We benchmarked the nearest approximations, the Silver-Reed EXP 550, the Brother HR-1, and the Smith-Corona TP-1. Good products all. But then we put the Juki 6100 through its paces against this checklist:

1. Print Quality. This is where it really shines. Our printer uses print wheels and ribbons designed not for computer printers, but for *typewriters*—where the standards for "letter quality" are set. The printwheels are Triumph-Adler style: true typewriter quality, because that's what they were designed for. What's more, the printer uses IBM's Selectric II typewriter cartridges, so enough said about quality of the ink and the print impression. Chances are you already stock these cartridges in your supplies cabinet.

2. Print Speed. Using the standard Shannon test for plain text, the Juki does a true 18 characters per second. That exceeds all three rival printers, and is half again faster that the Smith-Corona. But there is more. The Juki designers put in logic-seeking bi-directional printing and high speed motion over blank spaces. This means that typing speed on typical text is as fast as printers with much faster ratings. And there is a built-in, expendable 2,000 character buffer in the printer to free up your computer even before the printing is done.

3. Noise level. Quiet level is more accurate. The technical rating is better than 62 dBA from 1 meter away. If you don't know a dBA from a D&B, it means no raucous clatter to rattle the nerves, a big improvement over some printers we listened to. The other three are *two to eight times noisier.*

4. Reliability. The engineers know what an MTBF of 2500 hours at 25% duty means. More meaningful for most of us: there are very few moving parts. Other printers employ a complex system of electric motors, wires pullies, and springs. Not only do they break down, they also go out of adjustment. But the Juki uses a far more elegant design: the printhead glides across a rail by magnetic traction. That's all there is to it. If you look inside, you will see a startling simplicity.

5. Warranty. We give you a full 90 days limited warranty which covers parts and labor, but we don't think you'll be testing this part of our offer. Still, it's nice to know it's there. It means you really cannot go wrong by ordering this printer to put it through its paces.

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letter-quality printer for $499!

Shipping and Handling Extra

6. Versatility. Our printer can print at 10, 12 and 15 characters per inch and also take proportional spaced wheels for that extra touch of class. We also have an economical and reliable bi-directional forms tractor as an option, if you want to handle continuous stationery.

We supply a 100-character Courier 10-pitch (characters per inch) printwheel with the full ASCII character set and extra word processing symbols. The other three printers can't match that: Smith-Corona has only 88.

7. Physical Specifications.

Print Speed:	18 characters/second
Daisywheel:	Triumph-Adler compatible. Drops into place
Printing Characters:	100 per wheel
Printed Line Length:	110 characters under 10 pitch 132 characters under 12 pitch 165 characters under 15 pitch 82 to 220 characters under proportional spacing mode
Horizontal Resolution:	1/120 inch minimum
Vertical Resolution:	1/48 inch (1/96 inch possible by using escape sequence)
Platen Size:	13 inches (Printing line 11 inches)
Ribbon:	IBM82 Compatible multi-strike or single strike (Selectric II)
Interface:	Centronics parallel. Diablo® software compatible.
Power Consumption:	40 W idling, average 80 W printing
Dimensions:	Width: 20.5", Depth: 17.9", Height: 5.9"
Weight:	31 lbs.
Environment:	Ambient Temperature: 41° to 95° Farenheit Relative Humidity: 30% to 85%
MTBF:	2,500 hours at 25% duty
MTTR:	15 minutes
Noise:	Less than 62 dBA at 1 meter distance
Buffer Memory Size:	2K bytes installed, expandable to 8K.
Options:	Bi-Directional Forms Tractor, $129.00

8. Ease of Installation and Use. The Juki is fully compatible with your IBM PC or XT. Just plug it into the parallel printer port. And it works with the top-selling software products: the Juki follows standard Diablo® protocols.

- It's exasperating to be all set to go—but no ribbon. So we give you a ribbon. Loading is clean and simple—it's an IBM Selectric style cartridge, remember.
- We also give you a printwheel: a courier 10 (characters to the inch), the most popular typeface. The fun comes in loading it: just pull back a lever, and **drop it in.** No cover or ribbon removal, no inky fingers. No figuring out why it doesn't attach. It drops into a recess and the printer engages it entirely on its own!

9. Price. We have already covered this point. At $499, there is nothing to compare to.

Call us right now. Use our 800 number. Charge your purchase to MasterCard or Visa. Or send your payment or credit card information to the address at right. Here is what to ask for:

	Product Code	Price
Juki 6100 Printer	**J6100**	**$499**
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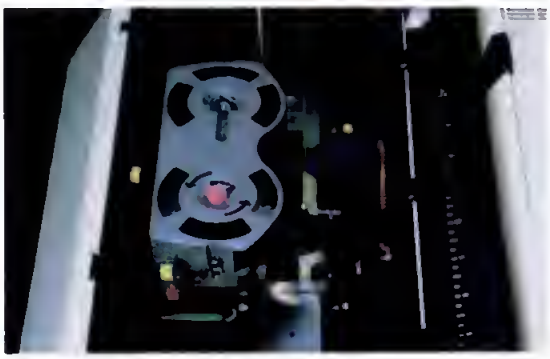
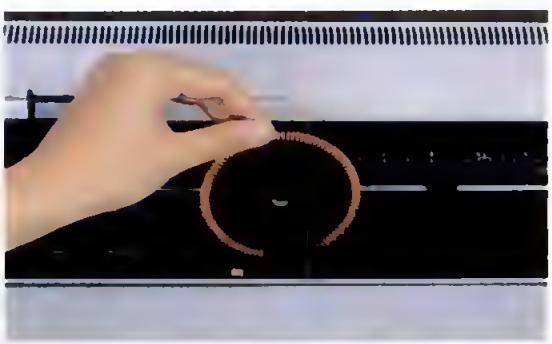


Above: Easily accessed controls are on the front panel. The printhead, ribbon, and printwheel are mounted as a single mechanism. Below: The printwheel simply drops into place; the printer engages it automatically!



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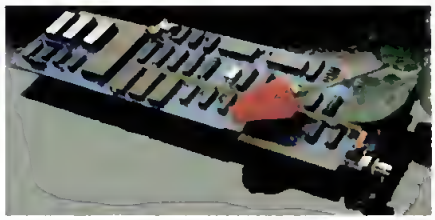

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CIRCLE 370 ON READER SERVICE CARD

IBM Personal Computer Trends and Developments

IBM News

FROM THE EDITORS OF PC

MARCH 20, 1984

IBM's Latest Hot Potato

PC/IX, Unix operating system for PC, kindles competition, controversy, contention. Interactive Systems Corp. looks like a winner, but Microsoft is out in the cold.

BY MARTIN PORTER AND CONNIE WINKLER

NEW YORK—IBM's announcement of a Unix-based operating system for the PC is the hottest hand grenade to hit the PC industry yet. Personal Computer Interactive Executive (PC/IX, as it's already handily known) will be based on AT&T's Unix and is a bombshell that's sure to boom!

Competitors don't know quite what to make of the announcement, new subcontractors invited to the IBM party are jubilant, IBM divisions not directly in on this one are scrambling to figure out what's going on, and old IBM paramours are clinging tighter.

Winners and Losers

"IBM has just set the standard for Unix in the micro industry," says John White, chairman and chief executive officer of Interactive Systems Corp. (ISC) in Santa Monica, California. His 7-year-old company has just been tapped by IBM to develop PC/IX. "We won the IBM bakeoff," he says.

Microsoft was similarly knighted when its MS-DOS operating system was selected for the PC, and thus became the industry standard.

"If the announcement came out of Boca Raton, it would be one thing," says John Ulett, marketing manager for Microsoft's Unix product, Xenix. "The reason we didn't get the product, I believe, was because it came from another group, not from Boca Raton."

IBM is sending a message, offers Ulett. The message, he believes, is something like, "Yes, we believe in Unix. Start writing for it. There will be a forthcoming machine that will have Unix, or some derivation."

"The PC/IX announcement is like hearing the first shoe drop," said John M. DeAno, president of Computer Technology Group (CTG) in Chicago, which specializes in Unix education. "You feel there is something else coming, but you don't know what it is."

DeAno's "what's going on here?" feeling was reinforced recently when CTG was called in to lecture to 200 IBM applications developers in Boca Raton on the wonders of Unix. (See related story.)

Whether the PC/IX an-

(continued)

Unix for the PC: What It All Means

IBM jumps AT&T Unix machine competition with Personal Computer Interactive Executive

BY BILL MACHRONE

IBM has announced a version of Unix for the PC-XT. Why? Because PC Unix vendors such as UniSource, Venturcom, Mark Williams and others were making too much money in a burgeoning market?

Hardly.

Because the market demanded a higher-powered operating system to overcome the inadequacies of PC-DOS?

Nope.

Could IBM be setting the stage for a new product, one that will use Unix? Is IBM seeking to protect its investment in system and application software for micros as it ventures ever further into more complex systems and more advanced processors?

You got it, pal.

Sometime in the latter half of 1984, you will see IBM's multiuser micro. Most prognosticators agree that it will be based on the Intel 80286 CPU chip and that it will run a version of Unix. From there, opinion (and that's all it is) diverges widely.

The question remains, though: Why now?

PC/IX, as IBM's first Unix is to be called, is not yet ready for release. The projected release

(continued)

Is the Boom Bust?

In a recent news story on computer retailing, "PC News" quoted experts who thought that a shakeout, especially among independent stores, might be on the way (*PC*, Volume 3 Number 3).

For some stores, it appears, those troubles may have arrived. One manufacturer and distributor of computer training products reports that the number of bad checks and unpaid bills they are encountering is rising. "From April to November of 1983, the amount of bad receivables was under $160—or less than I percent of our business," he says. "Since December, that rate has risen to more than 5 percent." According to our source, the typical rate of unpaid bills varies from I to 3 percent, depending on the type of business.

"My corporate customers are still paying on time and in full. The unpaid bills are all from retailers, so I have to wonder what's going on." ***—Karen Cook***

Hot Potato *(continued)*

nouncement is an offensive or defensive move by IBM toward AT&T depends on who's talking.

"IBM has taken some control over which version of Unix becomes the standard," said Kevin Gross, editor of *Yates Perspective*, a Unix newsletter. "It took the initiative away from AT&T."

Bell's Baby

Everyone agrees, however, that IBM's embrace of Unix is related to the 32-bit supermicrocomputer expected from AT&T. (After all, it was in AT&T's Bell Laboratories that Unix was born in 1969.)

"It's possible IBM would have made the Unix decision even without AT&T," says David Stein of The Gartner Group in Stamford, Connecticut. "If IBM intends to come out with larger microprocessors in the Intel series—the 80286 and 80386—they really need to have multiuser software."

Stein's interpretation of the Microsoft snub fits into the pattern IBM has followed with other suppliers, spreading its business and thus its risk among many smaller companies that it can control. As a result, IBM isn't dependent on any one supplier.

Microsoft is still in the game with MS-DOS. Subsequent PCs from IBM—most notably the expected 32-bit "Popcorn" multiuser PC—should run both the new Unix software and MS-DOS.

In addition, the PC/IX price—$900, and sold only through IBM's large accounts division—is prohibitive. MS-DOS can be had for $40 to $60 retail.

Cost Prohibitions

"The major market will be corporations that are large users and technical," acknowledges White about the price. "The nontechnical side will come, but it will come a little later."

PC/IX won't be out until April, so there are many unanswered questions about what the Unix standard will finally be. The Interactive product is based on Bell's Unix System III, although AT&T programmers are already on to System V and System 5.2.

As the first licensee of Unix in 1977, Interactive claims it further debugged the program, enhanced it, added a full-screen editor, wrote documentation, and included an array of office applications. Their product, IS-3, runs many office systems and has been sold to other vendors.

"Our system is compatible with any Unix AT&T has released to date," White said. "I assume that whatever system AT&T releases with its first micros will essentially be the same as what we have created for IBM."

Systems Compatibility

According to the *Yates Perspective* (launched by long-time Unix follower Jean Yates), System III Unix is compatible with System V via an upgrade, not unlike the compatibility familiar to IBM PC users with PC-DOS 1.1 and 2.0.

It is System V, however, that vendors new to this fray are endorsing and it's System V that AT&T is expected to use in its future microcomputers.

According to IBM, PC/IX:

- has a full-screen editor, much like Interactive's *INed* editor;
- has standard Unix functions: networking, command languages, file monitoring, text processing, a hierarchical file system, and program development tools;
- has C programming language, but no Fortran;
- has multitasking, but not multiuser capabilities;
- runs on the PC-XT without modification and on the PC with an expansion box;
- requires at least 256K RAM and a 10 megabyte hard disk;
- can co-reside on the same machine with PC-DOS.

PC/IX, was announced by the computer giant's Information Systems Group, the umbrella group for all the large systems divisions. This group is headquartered in Ryebrook, New York many miles from the maverick which pushed out the PC, Entry Systems Division in Boca Raton, Florida. ■

Product Review

Cheers! Drinks Are on the PC!

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List Price: $9.95
Requires: 64K RAM for DOS 1.1, 128K RAM for DOS 2.0.

If your personal computer is driving you to drink, *PC Bartendr* will tell you what to do when you get there. This program gives you access to 101 recipes for alcoholic beverages. You can search for a drink by name, category, or get a list of all drinks that include a certain ingredient. This last feature could help you decide how to kill the opened fifth of Pernod in your cupboard.

Do you want to know how to make a Manhattan? A Grasshopper? A Kahlua Kiss? Just press the function keys and move the cursor through a list of drinks to make your selection. If your tastes go beyond the drinks that are built into *PC Bartendr*, it's easy to add your personal favorites—up to 500 of them. Just press F5, insert the name, category, ingredients, and quantities when prompted, then add whatever comments (or warnings) you like. For an example, see Figure 1, a screen shot that commemorates the moment I added the Irish Daquiri (a St. Patrick's Day special) to *PC Bartendr*'s repertoire.

I suspect the program's creators get out of control occasionally. A few weeks after I received my review copy, I had a phone call from LH Software. "We've had a problem. Would you please send your program disk back to us?"

I replied that I knew of at least one problem with *PC Bartendr*. When I tried running it on an Eagle or Corona PC, everything worked fine except that the opening menu was invisible on the screen.

The voice from Colorado said, "Well...Thanks for pointing that out. But that isn't the problem I called about. Would you please send the disk back? You can keep a copy."

Puzzled, I asked, "So what's your problem, really?"

"Uhh...We wrecked our master diskette."

I sent the disk back to them before I had the presence of mind to telephone back and ask, "So what's it worth to you?" Due to my charity, it's still possible for you to obtain this entertaining program at a reasonable price. Order now—quickly—before this rumpus-room operation crashes its salubrious software again. ***—James Langdell***

```
Drink        Irish Daquiri
Category     Coolers
Ingredient   whisky
Measure      3 oz
Ingredient   creme de menthe
Measure      1/2 oz
Ingredient   crushed ice
Measure      1/2 cup
Ingredient   frozen boiled potatoes
Measure      1 cup

A tropical favorite from the auld sod.
(Creme de menthe added for coloring.)_
F1-Abort F2-Save F3-Category F4-Comment
```

Unix *(continued)*

date is April and as of mid-January, the demos were still crashing occasionally. Very un-IBM. That the announcement went out over the news service wire instead of via the more typical Mailgrams and press cooference, indicates a rush job to get the news out.

This marks the second time in as many announcements that IBM has released information on a new product before it is available. Also very un-IBM. In the case of PC*jr*, it seems that they just wanted to ruin everyone else's Christmas, a defeosive marketing move. What's the rationale behind the timing of the PC/IX announcement?

It's all centered around UniForum, the Unix industry trade show in Washington, D.C. There aren't all that many commercial shows targeted at the Unix community. Most of the get-togethers are user group meetings. So mid-January's UniForum provided a window of opportunity.

It also presented a threat to IBM, as it was widely rumored that AT&T would unveil its 32-bit Unix micro at the show. Not that there weren't plenty of other hardware vendors at the show: The Charles Rivers, Fortunes, Pixels, and Wicats can come and go, but when AT&T makes a move, IBM takes notice. As it turned out, AT&T didn't show its machine, so there sat IBM with its Unix demo, apropos of nothing.

Nothing, that is, except the entire future of microcomputing.

Unix to the Fore

Designers and marketers alike have been casting about for a suitable multiuser operating system to carry us through the latter half of this decade and beyond. MS-DOS over a network is fraught with complications once you get to the file sharing point. Digital Research's MP/M-86 is promising in concept, but self-limited as to the number of users and the "view" of system resources, seeing them in terms of disk drives instead of users. Oasis, a mainframe-like multiuser operating system, never excited anyone. Several excellent minicomputer operating systems, such as Hewlett-Packard's MPE and Data General's AOS would have been viable choices, but were too wedded to the partisanism surrounding the hardware they were designed for.

Unix, through its conception by the research-orieoted Bell Labs and its rearing in the universities of America, became the only viable choice. Good old inscrutable programmer-friendly-the-rest-of-the-world-be-damned Unix.

AT&T has recently entered into agreements with the major chip manufacturers to provide and support Unix System V (the latest versioo) on their new generation supermicrocomputer chips. IBM won't even have to stay with Intel to ensure upward compatibility. A quick compilation of the source programs and you're up and running on the new machine.

What It Means

The initial effect on PC users is minimal. There are already competent implementations of Unix available for the PC. About the only advantage to PC/IX is the IBM support and the full screen editor iotegrated with the PC keyboard. Being a "straight" System II implementation, it doesn't include some of the important Berkeley enhancements such as termcap and vi, a shortcoming. Virtually every other implementation of Unix has some of the Berkeley enhancements, including AT&T's current version of System V.

Versions of Unix that run on the PC will have a tougher sell. Even though other products may perform better (our in-depth analysis will tell the tale), there is an indisputable tendency to buy IBM.

IBM has essentially served notice that it considers MS-DOS to be a dead end and doesn't think much of Microsoft's Xenix. The Unix-like features of DOS 2.x are just teasers, and attempts to rebuild MS-DOS into a multiuser operating system (as some network vendors have done) are doomed to failure. Xenix appears destined for quiet oblivion as OEM manufacturers wait for Unix System V on their favorite superchip.

IBM has also turned its back on a wealth of operating system development for its own minicomputers, particularly Series I and Series 34-36. But these machines have been quietly losing ground in the mini market for years. You've got to support inexpensive ASCII peripherals and have good asynchronous communications to make a go of it in the mini arena, and IBM's current lineup doesn't cut it. Unix, on the other hand, lives and breathes ASCII and, through the magic of termcap, there's hardly a peripheral it can't talk to. Although at least one vendor has implemented Uoix oo the Series One, the design is just too ancient to be the basis of IBM's entry into the supermicro fray.

While IBM's mini line may fade into the oblivion it deserves, the mainframes are very clearly here to stay. But they too are touched by the changes wrought by Unix. The corporate network of the near future will have multiple ways for the supermicros to hook in, beyond the tried-and-true bisync emulators. A transitional mainframe operating system that can look like Unix or perhaps even like MS-DOS is a probability, since it is usually easier to get a mainframe to emulate a smaller machine than vice versa.

AT&T's Role

AT&T cannot help but be directly affected by IBM's move. After all, IBM is using a real, live Unix—not a workalike. Some pundits swore that IBM would never do anything that would cause them to pay royalties to AT&T, but pragmatism wins over corporate pride in this instance. AT&T is in the most enviable position of all: No matter what happens in the marketplace, they can't lose. Unix can only become more popular, creating additional demand for AT&T software and hardware. Only AT&T can use the word "Unix" in a product name, and if they're smart they'll call their micro "The Unix Machine" or something similarly pithy.

Workstations, Arise!

Once again, IBM has validated the concept of the workstation. First put forth by a variety of veodors in the Unix market, workstations have become an indispensable part of high-end systems development. IBM's first acknowledgment came in the form of XT/370 and 3270-PC, which permit a mix of mainframe and PC tasks on the same machine. Now PC/IX puts another grown-up operating system on the PC, allowing the programmer to develop applications locally, without burdening the main computer. At the same time, uucp, the Unix-to-Unix Communication Program, can operate in the background, giving the user access to the outside world.

Whether PC/IX is the tip of the iceberg or the edge of a minefield depeods on whether you're buying from or competing with IBM. In either case, it bodes well for the future of personal computing. ■

Fortune Smiles on Bill Gates

In its January 23 issue, *Fortune* magazine published an article about Microsoft Corp. that opened with a full-page photograph of Bill Gates, captioned: "Brainpower and ambition have made Chairman William H. Gates III a wealthy 28-year-old. His $750,000 house has an indoor pool."

If America's biggest business magazine gets so excited when it finds a corporation's chairman who can afford a swimming pool, the recoot recession must have been far worse than we ever expected.

Fortune's photo caption also impressed New York Times columnist Russell Baker. In his column, "Creature of Fortune," the best selling author depicted himself in the midst of a "pre-midlife identity crisis." Baker asked his psychoanalyst, "Am I too old to get into the Harvard Business School? . . . Am I also too old to be a fiercely ambitious 28-year-old driving to dominate the momentum business of software from my $750,000 house, which has an indoor swimming pool?" Russell, we like you just the way you are. ■

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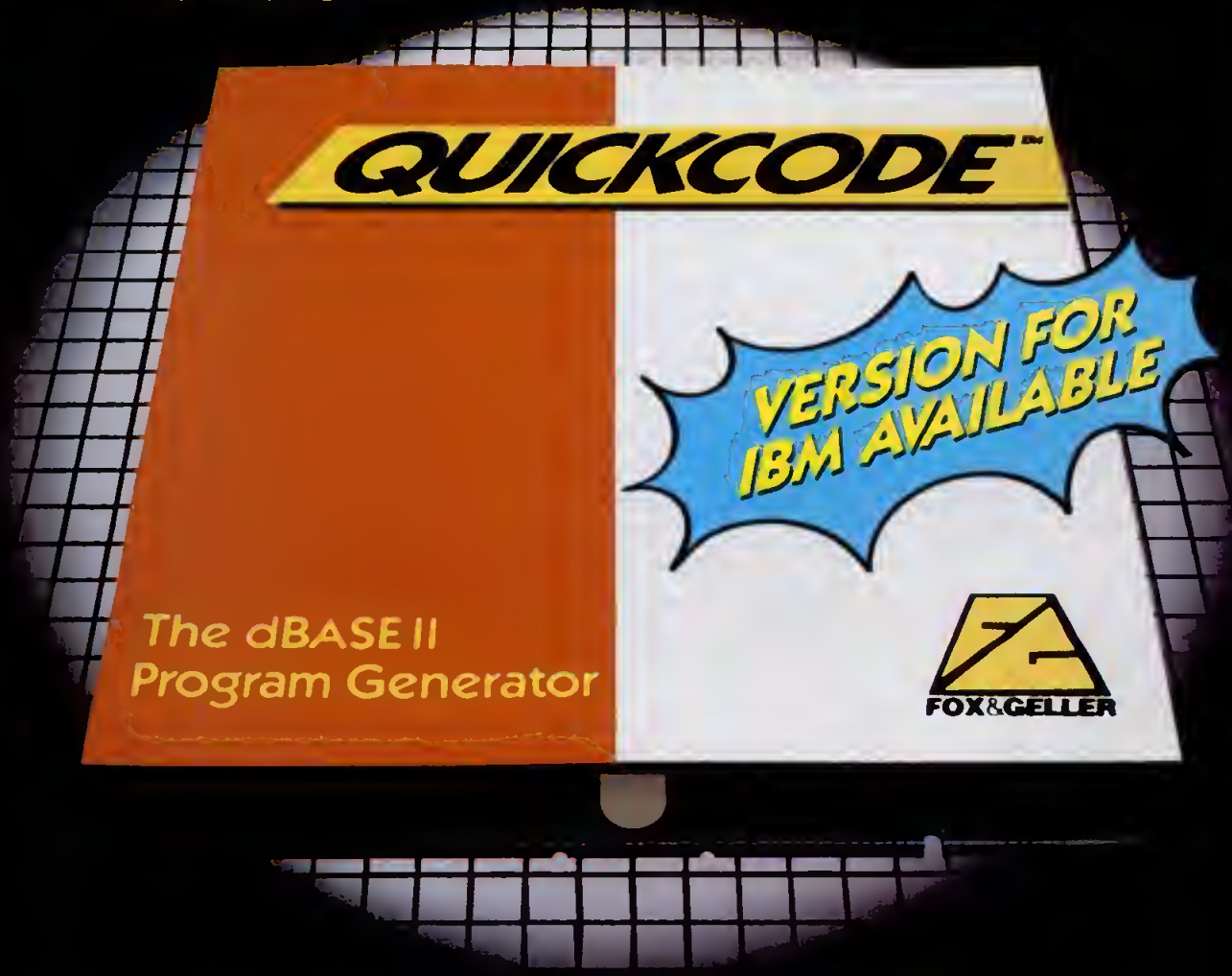

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Jumping From Iran to Unix CTG Again Hits a Hot Spot

Computer Technology group's seminar even tells IBMers about AT&T's operating system and C language

CHICAGO—PC users unfamiliar with Unix are not the only ones scratching their heads over IBM's Unix-based operating systems for the IBM PC. Late last year a popular Unix seminar group here, Computer Technology Group (CTG), was encamped at IBM's Boca Raton, Florida, offices, instructing IBM applications developers in the fundamentals of AT&T's operating system.

"It had nothing to do with the (PC/IX) announcement," says CTG's president John M. DeAno. "We were training applications staff. We never did know what they were developing. We didn't have to sign a nondisclosure agreement since there wasn't anything to disclose."

The information that was disclosed was that there are at least 200 programmers in Boca Raton at work on applications software for the PC's latest operating system. They are all graduates of the same Unix tutorial the CTG training corps has presented to Fortune 1000 firms and government agencies.

"Interest in Unix has clearly been growing," added DeAno. "As a result of the IBM announcement, even if you don't want to use Unix now, you have to at least know about it, if only to defend your position."

This is an increased demand with which CTG is prepared to deal. A 3-year-old division of the Chicago-based Telemedia company, an international training contractor, CTG began after Telemedia was caught in the fall of Iran. Telemedia quickly decided it was time to pursue more stable environments.

It oddly chose the volatile world of computer operating systems, selecting Unix as "most likely to succeed" and thus finding a growing technological niche where training was needed.

Unix Courses

CTG offers both on-site training with Onyx computers ("We even brought them to Boca," DeAno says) and videotape and videodisk tutorials. Their public seminars on Unix and the C language will be touring Boston, Washington, D.C., San Francisco, and Dallas during the next two months. (For schedule and price information call toll free: 800-323-UNIX.)

Courses include Unix Fundamentals, C Language Programming, and Advanced C Programming under Unix. On-site seminars are usually 12 sessions at $1,200 per tutor day. The videodisk versions—which are supplied with a Sony disc player, interface, and IBM PC—leases for $34,000 yearly and includes 105 floppies and 37 interactive disks. The entire CTG training program is based on System III Unix.

"When we started, everyone else was keying in on IBM and IBM-related software," DeAno says. "We focused in on the grass roots—that is where Unix evolved from. By now I don't think there is a single mainframe manufacturer that hasn't attended one of our seminars."

Computer Technology Group is located at 310 S. Michigan Ave., Chicago, IL 60604.

—Martin Porter

Satellite Forges Path for Database

DataPath added to SSI's growing family of WordPerfect versions

NEW YORK—Automatic pathfinding may become the newest buzzword in databases on the PC. Relational databases have the ability to "join" different records together based on like information contained in the records. Language-oriented databases such as *dBASE II* require programming to effect such joinings. Some of the more sophisticated minicomputer and mainframe databases perform this task automatically. One, *Informix*, for example, has recently migrated from the Unix environment to the PC.

It was only a matter of time, then, before some products native to the PC would incorporate this advanced feature. *PowerBase*, from GMS Systems, was the first on the scene, aptly calling its automatic pathfinding feature "datazoom." The latest entrant is Satellite Software International, creator of *WordPerfect*.

Its offering, introduced at Softcon, is called *DataPath* and uses windows to graphically display the navigation from one record type to another. While this on-screen representation of the database is a boon to the unsophisticated user, it doesn't interfere with the needs of more experienced users.

"It's a visual experience... and more fun to use," says W.E. "Pete" Peterson, vice president of marketing for Satellite Software International. The combination of windows, speed, and pathfinding make the product especially easy to use, he adds.

DataPath will soon be available for $595 on the PC (requires 128K RAM) and $295 for the PC*jr*.

More in the Family

Buoyed by the success of his company's word processor, *WordPerfect*, Peterson is understandably optimistic about *DataPath*. Since the company was started in 1979, revenues have been growing at about 25 percent a month.

The small, Orem, Utah developer also has a spreadsheet package up its sleeve—*MathPlan*—and several less expensive versions of the word processing package, including a $49.95 one slated for PC*jr*. *MathPlan Jr.* will be introduced first, with the full *MathPlan*—complete with business graphics and defined functions—coming later in the year.

The high-end version of *WordPerfect* costs $495; a less sophisticated package, *Personal WordPerfect*, sells for $195. This month, however, the company is expected to substitute *WordPerfect Jr.* for *Personal WordPerfect* at the same price.

And SSI is taking that step into new distribution channels with *WordPerfect Limited Edition*. At $49.95 it's targeted at new and young users and is expected to be sold through book stores and mass merchandisers.

Peterson attributes the success of SSI to the degree of "user-friendliness" in the products. Persons just used to typing on an electric typewriter learn *WordPerfect* more easily than those who have struggled through earlier generations of word processors, Peterson said.

But be dislikes the term "user-friendly." "It makes me think of drug users," said Peterson. "It doesn't mean that if you are drunk you're still going to be able to use the product." ■

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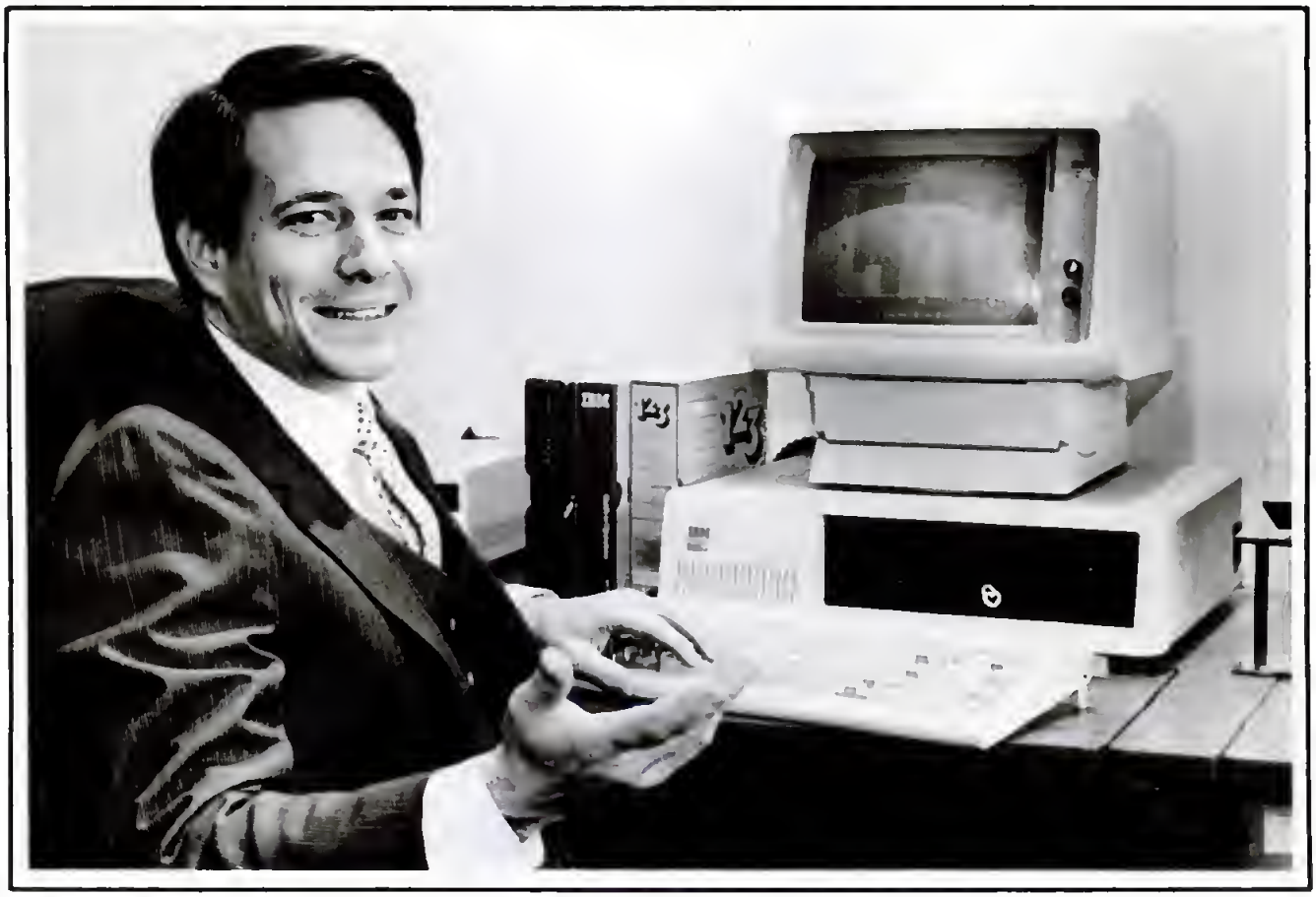

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The newsletter, planned for publication 10 times a year, will dedicate each issue to comprehensive reviews of a certain type of software. The inaugural issue in January, for instance, evaluated 30 word processing programs in ten different categories, including ease of use, ease of learning, performance, versatility, and value for money.

Software Digest, Inc., is the brainchild of Joseph M. Segal, the founder and former chairman of the Franklin Mint. Segal has been working with computers since the punch-card days, and got the first PC delivered to Philadelphia in 1981. As the number of software packages for the PC increased, Segal decided that users needed a rating service that would pit similar programs against each other while taking into account various levels of user expertise.

Last August, the 53-year-old Segal came out of a ten-year retirement to found Software Digest, Inc. He raised $1 million from private investors, bought 20 PCs, and hired 20 people—from computer novices to experts—to put software through its paces. The word processing tests began in November and took two months and $100,000 to complete.

The *Ratings Newsletter* is available from Software Digest, Inc., One Wynnewood Road, Wynnewood, PA 19096, (215) 649-7000. Subscriptions: $13.50 an issue, or $135.00 for ten issues a year. ■

Publishers Make Book On Software

Book makers hedge their inexperience with big money and marketing smarts

BY KAREN COOK

If the growing list of book publishers involved is any indication, the next meeting of the American Book Association may look like a software convention. Or vice versa. The list of publishing companies planning software projects includes Simon & Schuster, Warner Publishing, and Reader's Digest, as well as Houghton Mifflin, Random House, and McGraw-Hill.

The publishers have latched onto software for a simple reason: Particularly now that computers are being used at home, software seems sure to be a growth industry for years to come. Or, as Camilo Wilson, author of *Volkswriter,* puts it, "While the publishing business is in the doldrums, publishers see software publishers starting from zero and making millions—and they want some."

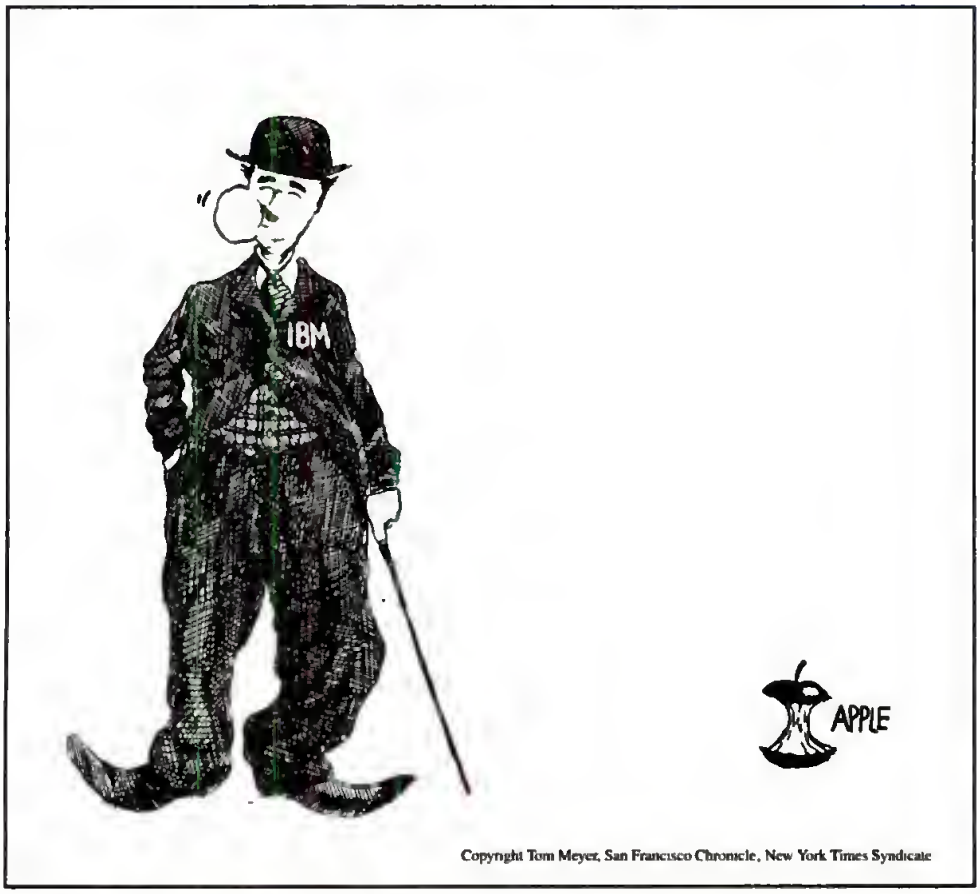
To many publishers, book and software publishing seem a logical fit. Like the book industry, software publishing combines entertainment and information and is structured around authors and royalties. On the surface, at least, the means of distributing books and software to the public are much the same. Frank Schwartz, president of Simon & Schuster's electronic publishing division, says, "Aside from understanding literary talent, what book publishers are best at is distribution and marketing." Conveniently, he adds, "the software business is becoming distributor- and retail-oriented. Publishers are going to need sophisticated marketing and distribution setups in order to compete."

Mass Merchandisers

Distribution in the software industry is complicated. Computer stores are traditionally reluctant to concentrate on software when they can make quicker profits on hardware sales. Some observers predict that book publishers will be only moderately successful in courting big chains like K Mart and JC Penney as outlets for software. As much as 25 percent of software is sold by mail order, another relative unknown for

(continued)

Windows From Around The Nation



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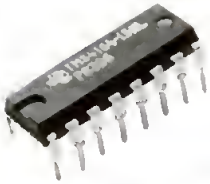

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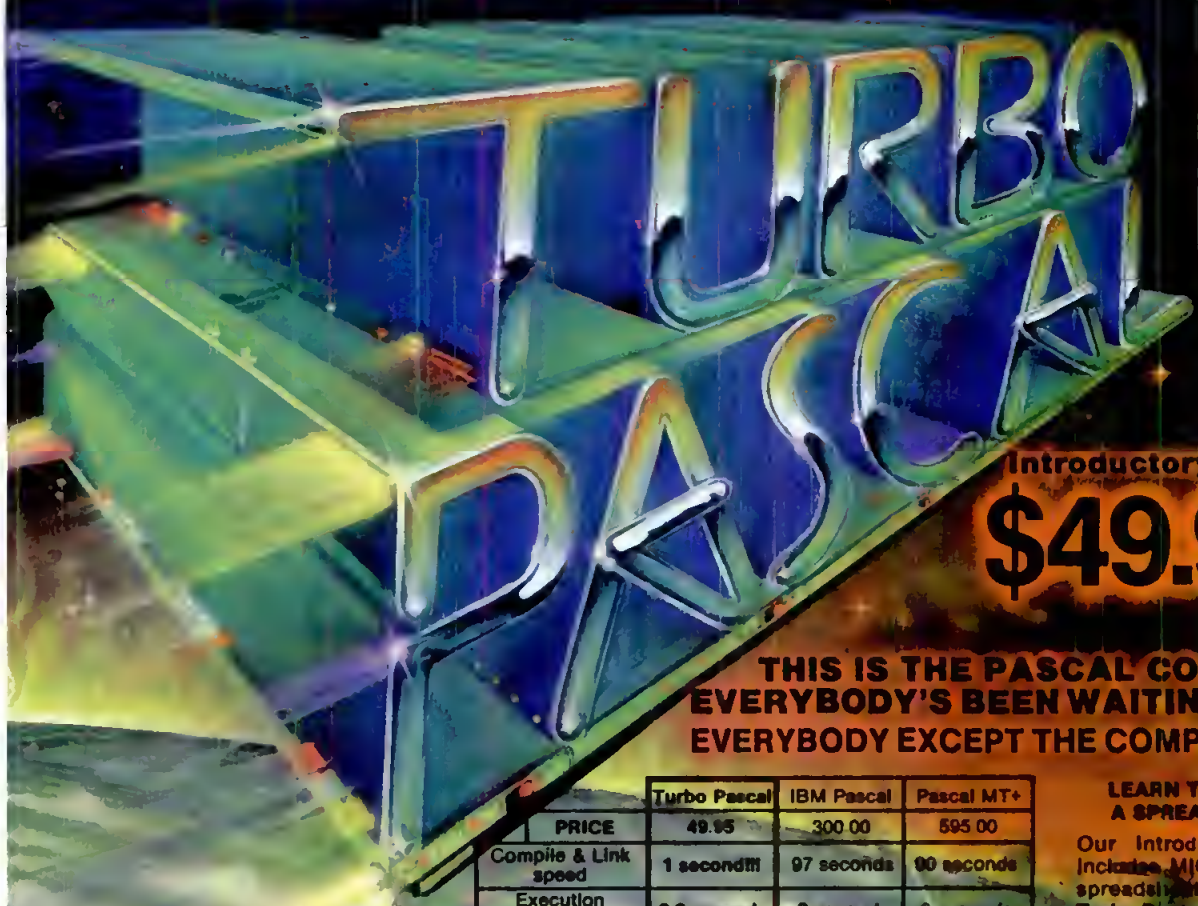

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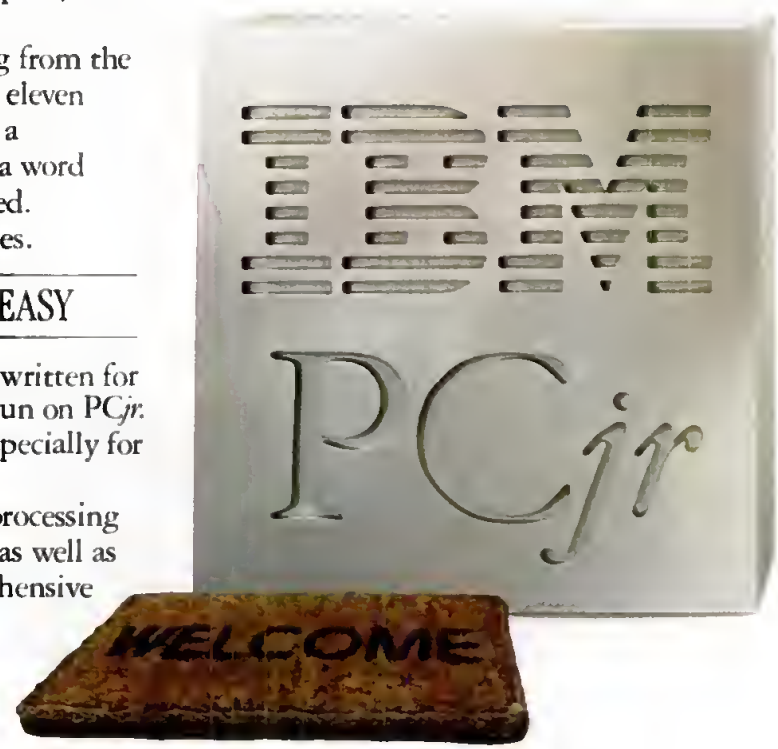

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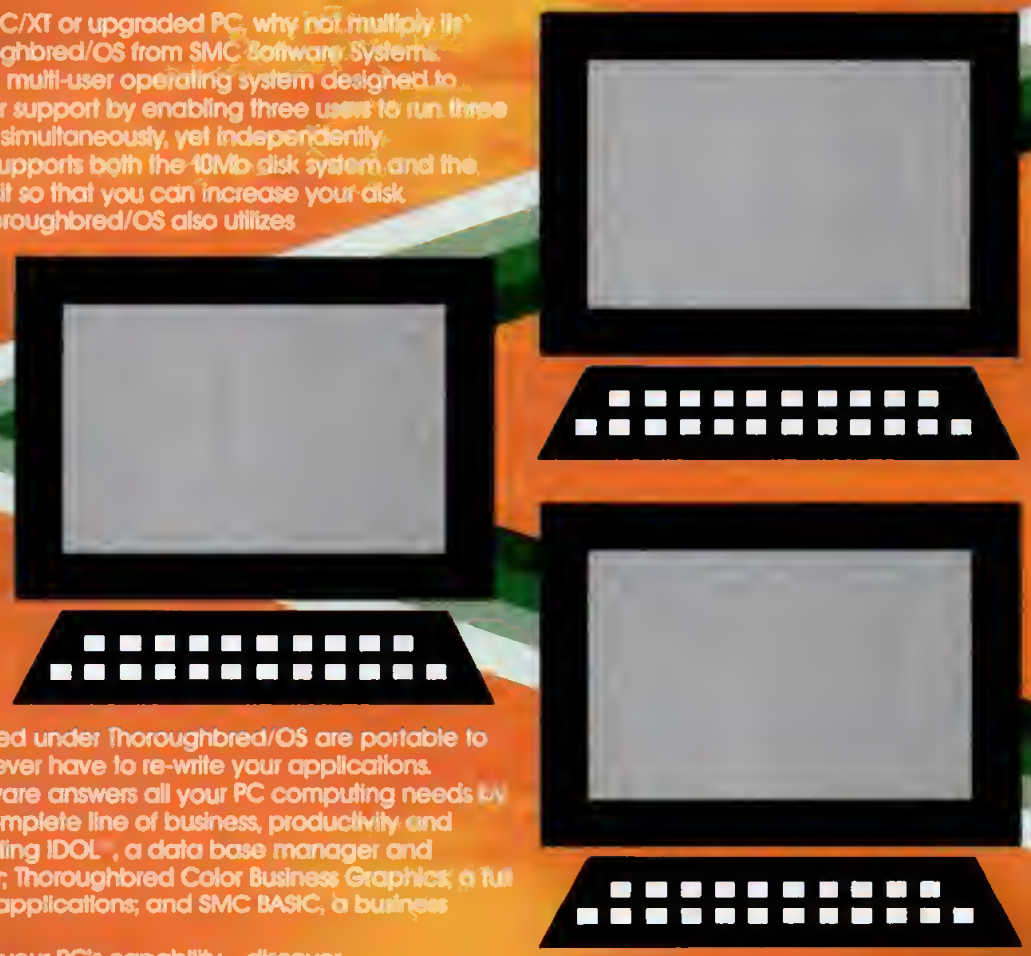

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CIRCLE 129 ON READER SERVICE CARD

Publishers *(continued)*

the book makers.

Simon & Schuster released its first software product in March. Schwartz says that publishing companies have dabbled in most of the many channels used for software distribution. "The big difference between us and some of the little guys is it's all under one roof," he says.

Schwartz says he might use the Pocket Books division to sell to chain stores, a new educational division to sell software to schools, or add software to the Simon & Schuster mail order house's line.

Nevertheless, many software publishers are still holding the idea of bookstore software merchandising—which has yet to take off—as a trump card. The audience is similar. "The demographics of people who buy books and people who buy software are basically the same, except that fewer women buy software," Schwartz says.

Observers doubt that bookstores will be able to sell expensive financial software or other complicated packages because they will not have the hardware to demonstrate the products. More likely, bookstores will sell simple, inexpensive products like video games or children's educational games, or perhaps inexpensive versions of established products. (See *People in the News*.)

Pretty Packages

The mass merchandising approach in bookstores may result in cosmetic changes for software—more sophisticated packaging, for example. "People will be much more affected by attractiveness of packaging. It's not the same now as it was a few years ago, when only hobbyists and technical people were buying. They knew about the software and they didn't care what the box looked like," says Richard Scott, director of Reader's Digest Software.

Some of these changes may come in the form of clear, easily-understood documentation that can be examined before the product is purchased, much the way people can flip through a book.

Promotions may also play a large part. Large publishing companies have the money to spend on splashy advertising campaigns in print and on TV.

Simon & Schuster is sending the author of its *Typing Tutor III* software on a talk-show and autograph-signing tour. Eventually, well-known book authors will be brought in to write the texts for adventure or science fiction games, joining the celebrities already lending their names to educational or self-help products, Schwartz says.

Controlling Costs

Even for wealthy publishing companies, software publishing has its risks. Treating software as a cheap consumer product could mean an end to the high margins that attracted many publishers to software in the first place. "People are going to have to find a way to keep prices up," says Schwartz. "Conceivably, publishers could price themselves out of the market," says Wilson. As a software author, he plans to protect himself by retaining rights to market his own products.

Software publishers must absorb higher production costs ($5 per disk, vs. $1.50 per book, according to Schwartz) and make careful choices about what software packages to convert and what quantities to produce for individual manufacturers' computers. Publishers are "horrified" by the thought of costly overstocks that will lead to book-style "remaindering," says Scott.

On the other hand, Scott says, it's easier to test software than a book before it goes on the market. "You can't try a book until it's off the press, but by then you've got a print run and it's too late. You're either stuck with it or it sells." Testing software will at least allow software companies to debug programs before they go on sale.

Creating bug-free software requires technical know-how, a commodity that book publishers have sometimes found in short supply. Scott of Reader's Digest, for example, knew little about computers when he was named software director. He learned "the hard way: sink or swim." Now Scott understands enough about programming to appreciate the difficulties programmers are having. "As an administrator, that's all I need to know," he explains.

The industry has also learned from publishers who lost money after they introduced seriously flawed software. "Most of us know that if you don't have the expertise, you hire the talent."

Exclusive Deals

Publishers can bolster their technical resources by signing deals like the one that software developer Fred Collopy of Conceptual Instruments, Inc. signed with Warner Software. Although Warner's will package, market, and distribute Conceptual Instruments' *Desktop Organizer* package, Collopy will retain control of future program development and handle customer support. If users have problems with *Desktop Organizer*, they will still be able to get help from the people who designed it.

Schwartz of Simon & Schuster expects that large, powerful companies may spell the end for "the garage operations using Softsel (a distributing company) as a means of marketing."

Collopy of Conceptual Instruments counts himself among those who think it's just as well. "We always wanted a publisher with access to markets and capital, plus the ability to assess and manage talent," he says. "Smaller companies can be more flexible and creative. We don't want to spend energy developing marketing and distribution organizations." ■

Commodore, Atari Join Software Game

Third-party software strategies: Atari pitches name; Commodore cuts prices

NEW YORK—Atari, Inc., and Commodore International, two pioneering home computer manufacturers, have decided to capitalize on their already widely recognized brand names by offering third-party software for other manufacturers' computers.

Atari, Inc. launched its Atarisoft third-party software division in May, 1983. The division shipped "billions of dollars worth" of games for the IBM, Apple, Texas Instruments and Commodore machines by the end of the year, senior vice president for hardware and software Fred Simon says. With that fast start, Simon hopes to turn Atarisoft into "the most profitable software publisher" by the end of 1984. Such success will be welcome at Atari, which suffered huge losses last year.

Although most Atarisoft releases have been conversions of best-selling Atari arcade games, Simon also plans to publish and market some software developed by other companies. Even in today's increasingly competitive software market, Simon says he has no doubts about getting his products displayed on store shelves. "We're Atari," he says simply. "We're the most well-known software company in the world, aren't we?"

While Atari will continue to emphasize the games that made it famous, Commodore Software will continue its parent company's aggressive price cutting policies. "We believe that the software market is going to grow and expand more than anything else and be extremely lucrative," division president Sigmund Hartmann told *PC* Magazine. "We believe that we can produce software at a lower cost and offer it to under users at prices they can afford. Our software will cost less."

Hartmann is still in the early stages of recruiting third-party software developers and hasn't fully decided which Commodore products to convert, but he expects to have "a lot" of packages available for computers including the PC and PC*jr* by the end of 1984. ■

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CIRCLE 477 ON READER SERVICE CARD

Dysan 3.25″ Disks With Hit Software

Disk maker adds spice to new format with built-in bestselling programs

BY JAMES LANGDELL

SANTA CLARA, CA—Small diskettes have been introduced in many different sizes and formats, but none has estabished itself as a standard so well as the 5.5-inch disk, which has become a fact of electronic life.

Dysan Corporation, a maker of rotating magnetic media, has entered the software publishing business in order to assure that programs will be available on its 3.25-inch disk. In the next year and a half, the Dysan Software Services Division plans to release editions of 200 top software packages, including programs from Microsoft, Digital Research, MicroPro, Peachtree, and Sorcim.

Having desirable software available on its disk should help Dysan in its efforts to convince makers of upcoming, smaller computers to install disk drives that are compatible with Dysan's 3.25-inch disks. The Dysan disks have 80 tracks per side and an unformatted capacity of 500 bytes per side. Disks in this same format are manufactured by Tabor, 3M, Brown Disk and Rhone Poulenc.

IBM PC owners who want to use these small-format disks can install a unit, being manufactured by Tabor of Westford, Massachusetts, that will have a pair of double-sided 3.25-inch drives that can fit into the IBM's A: drive slot. The Tabor unit will have an unformatted capacity of 2 megabytes and is expected to cost $700, according to Dysan Series Software's product manager Bob Moody.

Value Added

Dysan intends to make the software it releases more desirable by adding value in three ways. First, Dysan is producing new manuals for all the software it releases, standardizing the texts so that users will find information in the same sections of one Dysan manual as in that for another Dysan package. Second, a "Quick Start" tutorial will be added to each manual to teach users the program's most basic commands and operations. Moody explained, "Studies have shown that most users use no more than 15 percent of any program's features. We aren't going to delete any rarely used, specialized commands, but we'll make it easier for users to find the commands they'll use most often."

The third enhancement is Dysan's "Fast Track" packaging. Two copies of each disk will be supplied in each software package, so users can start using a program immediately without stopping to make the backup copy before doing anything else. In most of its products, Dysan will have necessary system tracks already installed on the disks, saving new users from going through operations that are sometimes more confusing than any encountered in the program itself.

Formats Galore

Other small-disk manufacturers bave offered a variety of formats—disks in 4-inch, 3.5-inch, and 3-inch sizes are available. One 3.5-inch format, offered by Sony and other manufacturers, encloses the diskette in a semi-rigid plastic "clamshell." The Dysan 3.5-inch Flex Diskette, however, comes in a flexible sleeve that's similar to the one on a standard 5.25-incb diskette. Metal hubs are used on both of these styles, but Dyan's bub is thinner.

How does the Dysan Flex Diskette compare with the clamshell? Moody claimed that the clamshell's moving metal parts could wear and break, and that the rigid case didn't assure enough flex for the disk when the hub was held in place. He pointed out that the durable appearance of the semi-rigid case, which has a metal protector that slides over the read/write slot, would give users a false sense of security. "They might not be as careful with those diskettes, and ignore the danger that dust and dirt on the outside of their cases could get jammed into the drive." Dysan Corporation is located at 5201 Patrick Henry Dr., Santa Clara, CA 95050. Tabor Corporation is at Lyberty Way, Westford, MA 01886, (617) 692-2535. ■

Peripherals, Add-ons Play Prime Time

Everyone knows about computers, but esoteric add-ons are still only for experts—right? Not according to Quadram Corporation, an Atlanta-based manufacturer of peripherals. The company is pitching its products to the masses with a TV ad campaign featuring computer graphics that has aired on such heavyweight broadcasts as the CBS Evening News, 60 Minutes, and the Super Bowl.

Is prime-time television the most efficient way to reach the 7 percent of the population that owns computers? Probably not, but people who already understand computers are not the main target of the ads. Instead, according to marketing services manager Bill Havro, Quadram hopes to educate potential computer consumers about one important fact: to get the most out of whatever computer they buy, they will have to spend money on peripheral equipment, too.

"Many people think they can buy a computer and take it home and start punching at it immediately, and that's not true," Havro says. Once consumers understand the need for peripherals, maybe they will look for Quadram, the company whose messages taught them to want more. "If you buy a PC, you'll probably need expanded memory, a buffer, and certainly a printer. We sell those products," Havro adds cannily.

Appropriately enough, the images in Quadram's commercial are entirely computer-generated. "Live actors would have cost half as much, but we could never have gotten as much information across in 30 seconds as we did with graphics," explains Havro. The half-minute commercial cost "in the neighborhood of $100,000" to make, he says.

To find out the results of that expenditure, Quadram will survey audience reactions in April, after the commercials end their 4-month run.

—Karen Cook

Next April 15th, you could be adding up your golf score instead of your taxes.

With your IBM PC and Best Programs' TaxCut™ program, you can use the long days and nights you used to put into preparing your taxes for something more enjoyable.

TaxCut includes two second-generation programs, one for tax preparation and the other for tax planning, pioneered and refined by tax and programming experts—and by PC users like you. With step-by-step, on-screen prompting, the tax-preparation program helps you prepare and print the 1040 long form and more than 30 other commonly used forms and schedules.

You don't have to know all the regulations. You don't have to figure out IRS instructions. If you need help, the on-screen prompter tells you exactly which page in the comprehensive reference manual has the answer. You won't waste time answering questions more than once because the program automatically transfers information from one tax form to another.

TaxCut also includes a tax planner program that allows you to decide for yourself whether or not to set up an IRA, what effect a new mortgage will have on your tax liability, and the tax implications of a wide variety of other financial alternatives.

TaxCut is compatible with the IBM PC, the PC/XT and the COMPAQ computer. The program requires at least 128KB memory and one double-sided diskette drive. Add Best's Professional Finance Program (PC/PFPII), which tracks and computes data for input into TaxCut, and you have a complete financial and tax package.

You can have the whole, proven, second-generation tax-preparation and planning package for $255.00. This price includes extensive customer support and a newsletter to keep you up-to-date. And both the cost of the program and the actual cost of doing your taxes with it are tax-deductible.

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Next April 15th, you'll be very glad you did.

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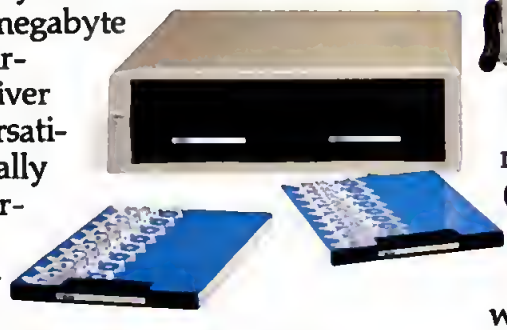

All of this in a package that smartly complements the styling of the IBM PC and XT—and fully supports DOS 1.1 and 2.0 software.

A Handful Of Cartridges Or A Desktop Full Of Hardware. You Decide.

The bottom-line beauty of The Bernoulli Box is that when you need more mass storage, you buy more cartridges—not more iron. So you save space, time, money, and get higher performance and a more reliable storage solution to boot.

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Tandy's Executive $11 Crystal Ball

When Radio Shack introduced the Tandy Model 2000, its first MS-DOS computer, it took a new tack with its TRS-80 line. All traces of the Radio Shack trademark were erased from this computer. Why? The old "shack" image was too downscale for the executive market the Model 2000 was aimed at.

Tandy Corporation seems to be selectively cleaning out the shack in the names of some of its other products. For example, we recently visited a Radio Shack and saw a table covered with small electronic toys, most of them Radio Shack-brand games. Mixed in with them was a slick black box, trimmed with imitation wood grain and chrome. Its front panel had a button labeled "Ask" and six LEDs tagged "Definitely," "Never," "Why Not," "Possibly," "Forget It," and "Ask Again." It's obviously an electronic upgrade of the old fortune-telling Magic 8-Ball, though it lacks the poetic spirit that could express sentiments such as "Future Hazy Try Again."

But what was the name of this $10.95 device? The "Tandy Executive Decision Maker." The Model 2000 is joined by another product that's too elite to bear the Radio Shack name.

After December 25, most stores slash the prices of leftover toys—and Radio Shack was no exception this holiday season. But one of its stocking stuffers proudly bore its full list price into the new year—the Executive Decision Maker. We see this as another sign that the Shackers get more serious when their products wear the Tandy brand. ■

Dr. Logo Is In—At Long Last!

The computer language that talks turtle is playful and powerful—but not quite as friendly as it may seem

BY JAMES LANGDELL

Dr. Logo
Digital Research Inc.
P.O. Box 579
Pacific Grove, CA 93950
List Price: $149.95
Requires: 192K minimum (256K recommended), one disk drive, color/graphics adapter, color monitor.

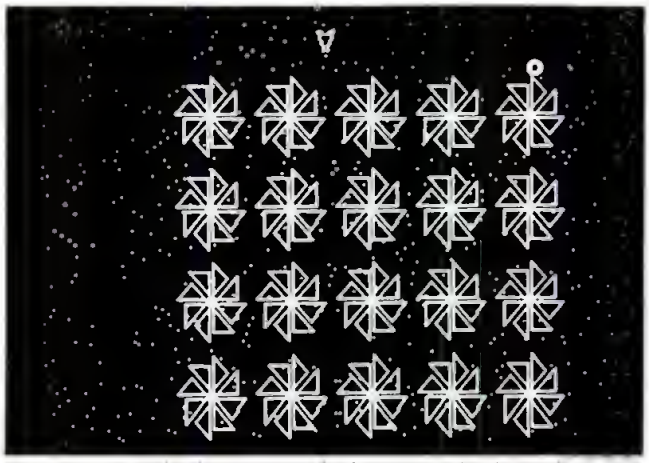
Early in 1983, Digital Research announced that it had created a version of the Logo language for the IBM PC (see "DR LOGO: A New Start For Beginners," *PC*, Volume 1 Number 11). Late last year, Dr. Logo finally appeared on the market. It took a few more months for Digital Research to respond to our requests for a review copy. After back orders were filled we finally got one—in fact, four copies of Dr. Logo were sent our office. One is being tested for a full review to be published in a future issue of *PC*; meanwhile, here are some first impressions of this long-awaited software.

Dr. Logo is now available in its "Advanced Version," which runs on the IBM PC and requires 192K RAM. This spring, Digital Research expects to release a version that needs only 128K RAM and is targeted to the PC*jr*. This product will be called the "Full Version" of Dr. Logo and will have a list price of $129.95.

Logo has been highly touted as an educational tool. Seymour Papert nurtured Logo at MIT in the early 1970s, simplifying the language until children could use it easily to program a computer with commands that manipulated a turtle. The turtle was originally a small robot. In more economical versions of Logo, the mechanical turtle is replaced by a symbol—usually a triangle—that appears on a video screen. The turtle can leave a trail of lines behind as it moves across the screen, and designs created by these lines are known as "turtle graphics."

Versions of Logo for other home computers have been available for a few years but the language has only recently become available for the IBM PC. Dr. Logo provides the PC with the most extended version of Logo running today on any microcomputer. It manages a larger workspace with far more nodes of memory than versions for other machines have offered.

Dr. Logo includes about 200 primitives—commands and functions that users call on to create new procedures. With this surfeit of primitives, did Digital Research lose the spirit of Logo in its quest to build a bigger language? Not to worry!



On closer examination, all the Dr. Logo primitives prove to be truly primitive; they expand the power of the language without preempting commands that users could have created.

Step-by-Step

A user who approached Dr. Logo as his or her first computer language would probably have a tough time learning it from the raw information in the *Reference Manual*. Most of its pages are devoted to explanations of individual Logo primitives, presented in alphabetical order. For each primitive there's a definition, comments, and a few sample procedures. The manual includes color plates that show screens with the graphics created by many of these sample procedures. But these procedures are presented without any tips that might have taught students how to create new procedures in a more creative way than to have them key in the printed listings verbatim.

Fortunately, there's also a tutorial called *Meet Dr. Logo* with clearer, step-by-step instructions for writing procedures to manipulate graphics and words. However, all the lessons in *Meet Dr. Logo* spell out exactly what the student should key in at any time. The text isn't designed to inspire students to create original routines.

Perhaps more creative instruction will be provided by a series of learning kits that Digital Research will start publishing this spring. The first learning kits are sets of program disks and flash cards to introduce children to subjects such as

(continued)

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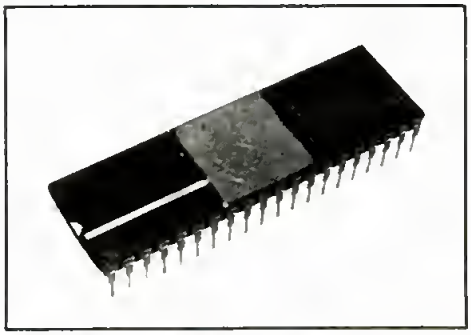

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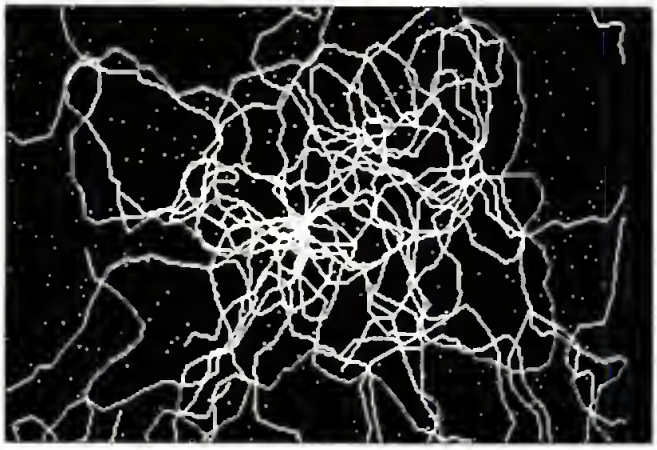
CIRCLE 331 ON READER SERVICE CARD

Dr. Logo *(continued)*

graphics, words, numbers, and games. These learning kits can also be used with Apple Logo and Commodore Logo.

Although Gary Kildall, president of Digital Research, has claimed that Dr. Logo is powerful enough for business operations, the company has no immediate plans to create business applications packages based on its implementation of the language. But Digital Research may still have this market in mind; one of the procedures in *Meet Dr. Logo* produces a bar chart.



How Does It Run?

PC owners often ask if they can use Dr. Logo without installing one of Digital Research's operating systems, such as CP/M-86. The answer is yes. In fact, this release of Dr. Logo is designed to run only under the self-booting Quickstart operating system provided on Dr. Logo's own copy-protected disk. Booting up the computer is the only way you can enter or exit from this language. In consequence, it's impossible to use a hard disk with Dr. Logo, but the program is designed to work well with only one disk drive. It's even possible to format additional storage diskettes in the midst of running Dr. Logo.

To use Dr. Logo, a system must have a color/graphics adapter and a color monitor. If there's also a monochrome monitor, it won't go to waste. With a two-monitor configuration, you can display all text on the monochrome monitor and devote the entire color screen to graphics.

How Easy Is It?

Once I got the hang of a few Dr. Logo techniques, I became absorbed in playing with the language. With proper coaching, I'm sure children would soon find ways to have as much fun as I did. But don't expect to buy Dr. Logo, hand the package to a child, and say, "Boot up this disk and go play." Beware! The program seems friendlier than it actually is.

When I first booted up Dr. Logo, this courteous greeting appeared: "Welcome to Dr. Logo. Please wait." It soon continued: "Hi! I'm in your startup file. You can type 'help' after the '?' for information about Dr. Logo primitives." How nice to have an on-line help system that seemed ready to take me by the hand and teach me to use the program from the very start.

I accepted this invitation and entered "help." "Please wait," said the ever-friendly program. "I'll give you a list of my primitives in alphabetical order." And then it filled the screen with the first few primitive names, followed by dictionary-style definitions. The screen offered no explanation of the syntax used with the primitives—the sort of information a user would need to refer to while writing procedures.

The program displayed a list of primitive definitions, one screenful at a time. If a definition wasn't finished by the bottom line of a screen, I had to go on to the next screen to see the remainder; there's no way to back up and refer to the first part of the definition again.

Better use is made of this file of definitions when the items are called on by name through a primitive named "poprim" (which means "print out primitives"). Digital Research is playing a cruel joke on Logo novices by passing off this primitive list as its help facility.

Another part of the language also appeared to have a bright sheen of user-friendliness. To save users from making too many keystrokes, some of Dr. Logo's most frequently used primitives can be written as abbreviations, for example, "fd" for "forward," "ht" for "hideturtle," and "pu" for "penup." These abbreviations, however, aren't included in the Reference Manual's index, nor is there a complete list of these abbreviations anywhere. If you see a procedure that uses an unfamiliar abbreviation, the hunt is on!

All things considered, I'm happy to see that Dr. Logo and his turtle have come out to play with us, and hope that any shortcomings will be fixed in later versions.

Doctor Logo, heal thyself! ■

No Matter Who's Invited, Some Will Turn Out To Be Incompatible

A few months ago, *PC Magazine* decided to give a party. We had become aware of the plethora of newly-announced micros touted as "PC compatible," and thought we should look into some of these claims. What exactly is meant by compatible? Does it mean the computer runs 100 percent of PC-DOS software, or only 70 percent? Or does it mean that the computer runs MS-DOS and therefore can run certain generic PC software as well?

So we invited 31 computer manufacturers who had, through advertisements or public relations statements, in some way indicated that they were selling a PC-compatible computer. We told them that we were gathering the computers in our offices, calling in our top technical writers and then, in the best *Car and Driver* tradition, putting the machines through their paces. Watch for our April 3, 1984 issue (Volume 3 Number 6).

Great idea—a chance for publicity that any computer manufacturer would leap at, right? Curiously, 14 of those 31 companies jumped backwards.

The demurrers fell into two categories: those whose computers were not quite ready yet and those whose computers were "not really PC compatible." For example, Televideo bought a 2-page advertising spread in the *COMDEX Program and Exhibits Guide* introducing its "complete family of IBM compatibles." But it was not able to find even one of those compatibles for us to test. Kaypro has introduced its Kaypro 4, which it claims can be upgraded to PC compatibility—but Kaypro did not have one to introduce to us.

Now, we do not want to single out these companies. They simply illustrate a tactic which is becoming more and more prevalent in the microcomputer community—predictive advertising. Computer manufacturers seem to feel that they have the right to make grandiose claims about their products months before they even exist. If, say, General Motors began advertising a gasless automobile in tomorrow's newspaper, knowing full well that the car wouldn't be ready until October, a horde of consumer groups would be on its case immediately. Yet in the hardware and software markets, any complaint brings only a shrug and a "What did you expect?"

Not all of the computers that we have reviewed for compatibility fulfilled their advertising claims. But at least those computer companies had enough confidence in their products to put them on trial. That so many computer manufacturers were either not prepared or not interested in submitting their computers for testing does not speak well of the industry. We hate to think that, after going through all that trouble to give our party, manufacturers didn't think enough of their own products to come.

—Barbara Krasnoff

Calendar of Events

DATE	EVENT	COMMENT	LOCATION	CONTACT
March 22-25	West Coast Computer Faire	Hardware, software, and speeches by industry executives	Civic Auditorium and Brooks Hall San Francisco, CA	Computer Faire 181 Wells Ave. Newton, MA 02159 (617) 965-8350 (415) 364-4294
March 29-31	Physicians and Computers	Applications in patient care	Las Vegas Hilton Las Vegas, NV	University of Southern California School of Medicine Postgraduate Division KAM 307 2025 Zonal Ave. Los Angeles, CA 90033 (213) 224-7051
March 30	Legal Aspects of the Software Acquisition	Seminar for data processing and legal professionals	Boston Park Plaza Boston, MA	The American Institute for Professional Education Carnegie Bldg. 100 Kings Rd. Madison, NJ 07940 (201) 377-7400
April 5-7	COMDEX/Winter	Hardware and software for dealers, retailers	Los Angeles Convention Center Los Angeles, CA	The Interface Group 300 First Ave. Needham, MA 02194 (800) 325-3330 (617) 449-6600
April 9-11	National Online Meeting	Presented papers and project review sessions	Sheraton Centre Hotel New York, NY	Learned Information, Inc. 143 Old Marlton Pike Medford, NJ 08055 (609) 654-6266
April 13-15	Interstellar Personal Computer Show	Hardware and software	Spokane Interstate Fairgrounds Spokane, WA	Hey-Mac Promotions E. 3607 33rd Spokane, WA 99203 (509) 534-3661
April 17-19	Federal DP Expo	Hardware and software aimed at MIS managers. Emphasis on integrating desktop computers to mainframes.	Washington Convention Center Washington, DC	The Interface Group 300 First Ave. Needham, MA 02194 (800) 325-3330 (617) 449-6600
May 3-6	The Mid-West Apple/ IBM PC Expo	Trade and end-user events	Rosemont Exposition Center Chicago, IL	Northeast Expositions 822 Boyleston St. Chestnut Hill, MA 02194
May 22-25	COMDEX/Spring	Hardware and software for dealers, retailers	Georgia World Congress Center, Atlanta Apparel Mart, and Atlanta Merchandise Mart Atlanta, GA	The Interface Group 300 First Ave. Needham, MA 02194 (800) 325-3330 (617) 449-6600

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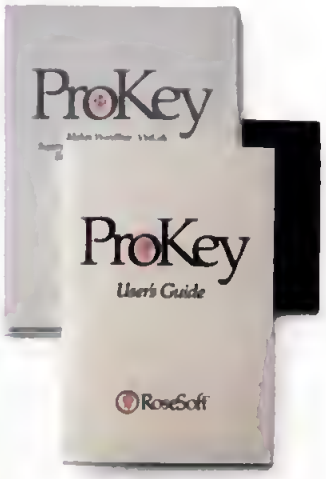

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To run ProKey, you'll need an IBM Personal Computer or workalike, DOS (any version including 2.0), and 64K of RAM (WordStar requires 96K).

WordStar, VisiCalc, Lotus 1-2-3 and dBase II are trademarks, respectively, of Micropro, VisiCorp, Lotus and Ashton-Tate.

CIRCLE 438 ON READER SERVICE CARD

Boeing Firepower In PC and XT/370

Executive workstations use Boeing's software and powerful mainframe services

BY JAMES LANGDELL

NEW YORK—The Boeing Company may be best known for its 747s, but it needs a lot of computer power to make its aircraft take off from the drawing board. So, the company created an operating division, the Boeing Computer Services Company (BCS) headquartered in Bellevue, Washington, that now has $500 million worth of computer equipment and 8,000 employees. In addition to serving Boeing's own needs, the division sells data, software, and training services to other customers. Now Boeing has put many of its software and data services within reach of an IBM PC, XT, or XT/370.

BCS offers two Executive Information Service (EIS) MicroWorkstations, described by its president, Robert L. Dryden, as "a family of PC products geared to the needs of the financial manager, budget planner, and corporate analyst."

One EIS MicroWorkstation is built around an IBM PC or XT, offered through a Value Added Dealer agreement with IBM. Boeing bundled in software that lets the micro link up with a mainframe to access Boeing's EIS databases, up and download data, and emulate a 3270 terminal. The software in an individual EIS station also gives it offline capabilities for data collection and editing, spreadsheet manipulation, and graphics.

The PC version is priced at $6,600, which includes Boeing's EIS software, PC-DOS 2.0, and an IBM PC with 128K, two 360K disk drives, a color monitor, and a graphics printer. A version using a PC-XT sells for $8,700. The EIS MicroWorkstation packages include one year of $500-per-month credit for using Boeing's MAINSTREAM remote computer service.

XT/370 Workstation

Boeing also offers a workstation built around the XT/370, which can perform modeling and forecasting functions in its local processing mode. This XT/370 station is fully compatible with MAINSTREAM utility service functions, including large-job processing, database management, and data transmission.

With this system, Boeing provides its *Scholar/Teach 3* software that trains users to operate the XT/370 and EIS software. Customers can also use *Scholar/Teach 3* to create courses to suit other applications.

BITS and PCs

Another Boeing product that can involve IBM PCs is Boeing Intelligent Terminal Services (BITS). This software package enables a variety of microcomputers to be integrated into a single system using a common language, so that a number of different functions (including those found in personal productivity software packages) can be performed with one standardized program. While Boeing's EIS offerings are intended to be used by executives, a BITS system is usually used to operate a group of microcomputers as workstations for entering and preprocessing batches of data.

For more information, contact Boeing Computer Services Company, 7980 Gallows Court, Vienna, VA 22180, (703) 556-3730. ■

Treasures Buried In BASIC

One of our readers, Ray McVay of Arlington, Texas, dug around in the IBM BASIC 2.0 interpreter and discovered four keywords that were left undocumented: ERDEV, ENVIRON, IOCTL, and SHELL. The code for these must have been incomplete at the time of last year's release of BASIC 2.0, but they may have come to life in future releases of Microsoft's BASIC.

ERDEV currently appears to be disabled. This keyword only produces syntax errors when entered from BASIC's direct mode.

ENVIRON is a statement, which takes a string variable or a literal string as an argument, that adds the string to the current "environment." An environment is the set of strings displayed when you type SET while at the PC-DOS command level (this is described on pages 10-21 and E-4 of IBM's DOS manual).

IOCTL is a function that takes the channel number of a currently open file (or perhaps a device) as its argument. When complete, this function may be an interface to the device driver. (Chapter 14 of the PC-DOS 2.0 manual includes two device driver functions that read and write IOCTL bytes for a device.) If you try using it now, IOCTL returns syntax errors when you give it a valid file number.

SHELL is the most interesting of these keywords-in-progress. It is a means of executing PC-DOS commands from within the BASIC interpreter. You can see it work well enough already to make you wish Microsoft had had enough time to finish it. SHELL takes a string as its argument, which it uses as the command line for COMMAND.COM, the PC-DOS command processor.

The presence of SHELL will be of major consequence if MS-DOS 3.0 provides direct support for multi-tasking. To explain in terms familiar to users of UNIX (or Microsoft's XENIX), SHELL creates a process that is a "child process" to a "parent process" (in this case, the BASIC interpreter). As it stands now, BASIC waits until the child process (created by SHELL) is completed, then BASIC continues performing its own task. In a multi-tasking system, however, the parent process would not have to wait for the child.

McVay said he found these keywords by exploring the BASIC interpreter's code. Afterwards, he realized there was a shortcut to these unmapped islands of language. All four terms can be found in a list of reserved words in the BASIC 2.0 manual. Although ENVIRON, ERDEV, IOCTL, and SHELL are mentioned nowhere else in the documentation, there must have been some good reason to warn users against assigning these terms to anything else. ■

Do Computers Corrupt the State?

"What Mr. Burnham is writing about is not so much the evils done by the computer as the corruption of American society—corruption concerned with power more than money. If a head of state connives to use people's tax records to cause them political damage, or a local policeman uses someone's criminal record for petty blackmail, it is society which is guilty for allowing it to happen and tolerating it once discovered. Whether a computer network was or was not instrumental in the crime is incidental."

The Economist, January 14, 1984, reviewing David Burnham's book, *The Rise of the Computer State*.

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People in the News: Camilo Wilson

From the moment he saw the PC, the man behind Volkswriter knew what a word processor should be.

BY CONNIE WINKLER

"Too dinky. I'll pass," said Camilo Wilson when he first investigated microcomputers in the late 1970s.

Then along came the IBM PC. "In June 1981 it was absolutely clear to me. I knew the name 'IBM' made it and I put my deposit down." He camped on his computer dealer's doorstep (along with Andrew Fluegelman) and got one of the first 10 PCs available in California.

Having just moved to California after 9 years as director of publishing for the Arica Institute in New York City (a leading human potential organization), Wilson intended to write a book about the PC.

He was short circuited. The word processing software then available for the PC (remember *EasyWriter I.0*) was such that he couldn't begin to write a book with it. A self-taught programmer, Wilson quickly launched into developing a better word processing package. He worked his way through the University of California at Berkeley to a mathematics degree with programming jobs.

And, he had a good idea of what a word processing package could do, having worked regularly on a dedicated word processing system from one of those since-vanished companies.

Timing couldn't have been better. He submerged himself and a "pretty intense" 3½ months into writing in Pascal a word processing program for the IBM PC.

Window of Opportunity

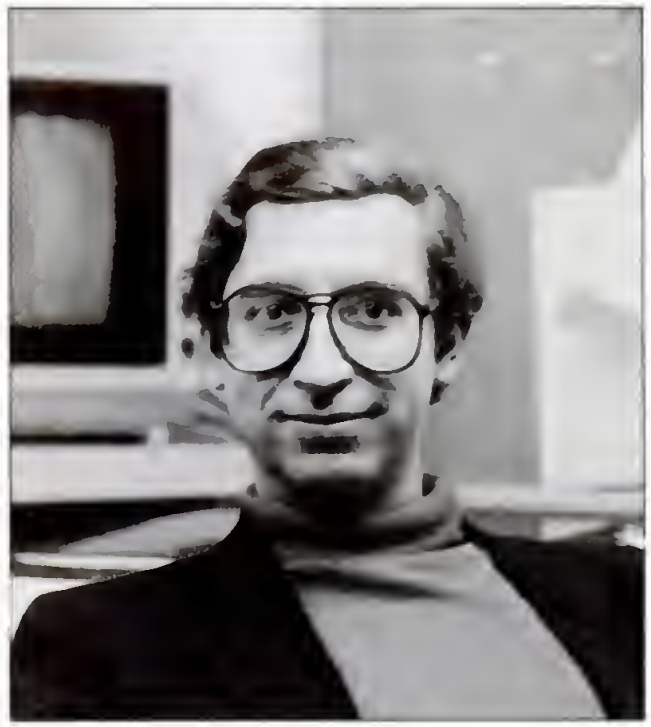
"We had a 3-month window when we were the only viable word processor for the PC," recalls Wilson. It was the period when everyone was waiting for the IBM version of *WordStar*. Wilson's product was relatively easy to use in the fashion of the standalone word processor and maintained ASCII file compatibility.

Wilson borrowed $15,000 on his own and launched *Volkswriter*. "We couldn't go to a publishing company because I didn't have a track record," recalls Wilson.

The window was open just wide enough for *Volkswriter* to establish itself as a strong package (typically on the Softsel best list) and capture a niche of users—most critically in the office marketplace. In fact, there are now about 40,000 registered *Volkswriter* users out there—and the package remains not copy protected.

Dare not any of those users—especially in large corporations mess around? "I'd sue...if I could get my hands on them," Wilson says about corporate employees—and corporations—who might illegally copy *Volkswriter* for themselves or for fellow workers.

"If I'm going to go after anyone legally, I'd go after the big guy," said the 36-year-old entrepreneur. Wilson has been active on the ADAPSO task force on microcomputers that is considering the software copy protection question. (ADAPSO is the Association of Data Processing Services Organizations, a software industry group.)



Camilo Wilson, president of Lifetree Software: His *Volkswriter* word processor is only $195—and may soon be cheaper. Wilson refuses to copy protect his program, but says of big corporations that pirate software: "I'd sue if I could get my hands on them."

Deluxe Model

The $195 *Volkswriter* package proved not as perfect for the offices as all those users wanted. Because of their many suggestions the product has been improved with a text-merge, list-making capability; bold facing; and 1,000-page storage capability. The latest $295 version is *Volkswriter Deluxe*.

Having a bestseller for the office environment is both a plus and a minus, tells Wilson, who now heads his 27-employee company Lifetree Software, Inc. in Monterey, California.

Forty to sixty percent of Lifetree's sales are direct to corporations most of which are entitled to additional services: hot-line telephone service, training, and special adaptations such as to a special printer.

"I'll go home if we don't make $5 million this year," tells the Santiago, Chile native, who was in New York recently, looking for yet more ways to do that. The company has grown to $2 million in sales in two years.

One way to extrapolate that growth is by finding new distribution means. At the booksellers' convention 2 years ago there was little interest by the book publishers or sellers in going into software. But Wilson remains interested in cutting a deal—perhaps crippling *Volkswriter* in some way—and offering it for between $50 and $100. It might be packaged under, "How to Scribble," he jokes. ■

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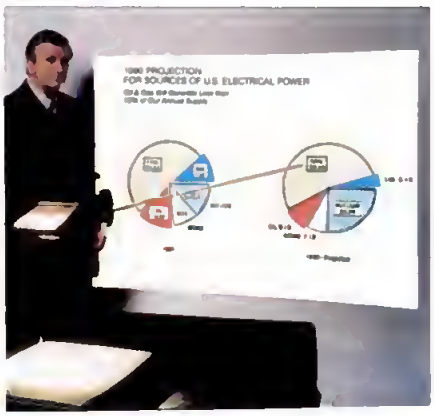

2. A PLOTTER, if you want presentation-quality color graphics, or a PRINTER (except if you have an Apple IIe), if you want black-and-white graphics.

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IF YOU EVER HAVE A PROBLEM or a question about CHART-MASTER, SIGN-MASTER or the hardware, you can reach a live, warm human being who will answer it, by calling the CHART-MASTER HOT-LINE at Decision Resources (203) 222-1974.

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BUSINESS GRAPHICS MAKE THINGS HAPPEN – as shown by the following Wharton Business School research.

When graphics presentations in business meetings, using an overhead projector, were used:

BUSINESS DECISIONS FAVORED THE GRAPHICS PRESENTER – 68% favored the presenter's point of view when charts and graphs were used, only 32% favored the presenter when none were used.

PRESENTERS WERE PERCEIVED AS PROS – Presenters using charts and graphs were considered more professional, persuasive, effective than the presenters who used no graphics.

GROUP AGREEMENT WAS GREATER – 79% reached agreement in the group using a graphics presentation vs 58% in the control group using none.

MEETINGS TOOK LESS TIME – 28% less than when no charts, graphs or other visual aids were used.

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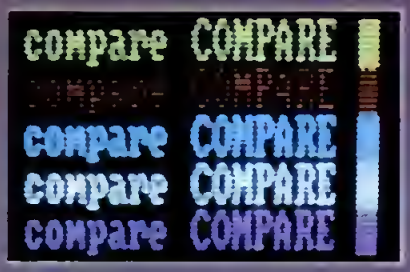

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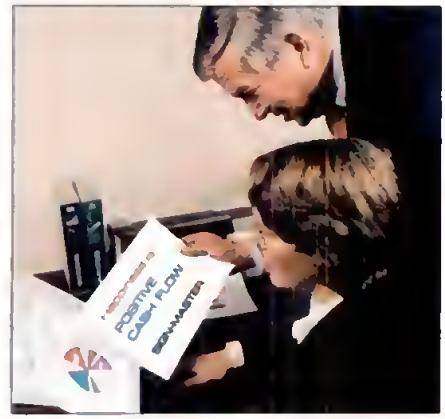

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Pitfalls Of Corporate Copying

Illegal "sharing" of programs within corporations is provoking software vendors to take action. But the complex issue of copy-protection presents a double-sided dilemma.

The PC has been welcomed into the hearts of corporate America and you'd think that the big software vendors would be jumping for joy. Well, they are, but their dreams are disturbed by visions of Amalgamated General Industries buying 2,000 PCs, a copy of *SuperCalc*, and a truckload of blank disks.

How bad is corporate copying? Pretty bad. In terms of sheer size and impact on the profitability of software vendors, it dwarfs copying by hobbyists and home users. The crime—and it is a crime—takes two major forms.

Amoebic Diskentery

The first kind of offender is just lazy. Perhaps he even thinks he is saving his company a buck. It's convenient to just stroll down the hall to visit a colleague who has had a PC for a couple of months and ask for a copy of a program to use "while mine's on order." It's likely, though, that the new user will never place that order—not out of malice, but inertia. After all, who wants to go up against the stultifying bureaucracy of most corporations just to get something he already has? Many a user will consider himself lucky to have obtained a PC at all and will figure that it's best to quit while ahead.

A variation on the theme is the Amoebic Boot Disk. A disk begins life with perfectly legitimate copies of, say, *VisiCalc* and *MultiMate*. It bears the label "Jane's Disk, Drive A." Then Jane sees her friend using *dBASE II* and says, "Gee, that's just what I could use for organizing my contact files." The hungry disk drives whir, and Jane's directory grows. One of Jane's subordinates brings in a copy of a program that his son uses in a college statistics lab. Some enterprising student has thoughtfully patched out the sign-on message to assuage any potential twinges of guilt. But the fourth-generation, photocopied manual bears an historical resemblance to a $295 package that Jane saw at the local computer store. She makes a mental note to ask her boss for a legit copy some day. Meanwhile, the monster feeds and Jane's directory expands again. Will she ever buy legitimate copies of the software she's using? Probably not until the Amoebic Boot Disk runs out of space, if ever.

Bill Machrone

The second breed of corporate copier is deliberate in his actions. He buys blank disks and binders for photocopied manuals and hides behind a mask of corporate respectability. He often runs elaborate training programs, has documentation customized to his firm's applications, and is possessed with a zealot's desire to spread the word on computers throughout the corporation. So blind is his ambition that he can't see that what he's doing is wrong.

Most corporate executives and lawyers are utterly unaware that either type of copying is going on, although it may be happening right outside their office doors.

End of the Line

Many vendors believe that it's time to end their largesse in providing free or nearly free software. They are now attacking on two fronts: copy protection and litigation.

For purposes of discussion, copy protection is any scheme that prevents copying or limits the number of copies that can be made of a piece of software. Of the two approaches, copy protection has by far the knottier problems. First, is there such a thing as true copy protection, or does it

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Accounts Receivable	$159
Accounts Payable	$159
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Inventory	$159
Bill of Materials	$139
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Sargon III (New)	$37

INFORMATION UNLIMITED

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EasyPlanner	$149
EasySpeller II	$99
with Webster Legal Spell	$209
with Webster Medical	$209
Easy Mailer II	$65
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Accounts Receivable	$359
Accounts Payable	$359
Inventory Control & Analysis	$359

IBM SOFTWARE

Order Entry	$359
SUPERBUY PACKS!	
General Ledger, Financial Reporter, Accounts Receivable, Accounts Payable	$899
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First Class Mail	$89
Property Management	$349
Tax Advantage	$39

SUNDEX

Certified Personal Accountant	$119
Certified Personal Investors	$119

SELECT

(Specify DOS)	
Select Write & Teach	$89
Select Word Processor (includes Teach, SuperSpell, Merge, Print)	$269

INTESOFT

The Next Generation!	
InteCalc (3-D spreadsheet)	$269
InteWord (25 more features than Wordstar)	$369
InterPert (Critical Path)	$179
IntePlan (Time Management)	$129
ALL OF ABOVE JUST	$799

XQ SOFTWARE

Tax Strategist	$289
Investment Strategist	$289

LINK SYSTEMS — But for You!

DATAFAX	$199

INSOFT

DATA DESIGN	$179
GRAFORTH	$59
TRANSFORTH	$99

XOR SOFTWARE

C TOOLS UTILITY	$79
THOTH DATABASE	$79
BLUE CHIP PORTFOLIO	$66

MAXELL DISKS

MD1 Single Sided Double Density	$27
MD2 Double Sided Double Density	$40

NEW!

BLUE SKY SILICON OFFICE	$789

LEISURE SOFTWARE

Sega Star Trek	$33
Sega Zaxxon	$33
Hesware MinnFats Pool	$25
Hesware Gridrunner	$25
Avalon Diplomacy	$45
Avalon T.A.C	$33
Spinnaker Facemaker	$23
Spinnaker Delta Drawing	$37
Spinnaker Fraction Fever	$23
Spinnaker Hey Diddle Diddle	$21
Spinnaker Most Amazing Thing	$27
Spinnaker Rhymes & Riddles	$21
Spinnaker Story Machine	$23
Spinnaker Snooper Troop I	$30
Spinnaker Snooper Troop II	$30
Epyx Temple of Apshai	$27
Epyx Upper Reaches Apshai	$16
Epyx Curse of Ra	$16

PERIPHERALS

MONITORS

	But for You!
BMC 13" Composite Color Plus	$229
BMC 12" Low Res Green	$85
BMC 12" Hi Res Green	$119
BMC 12" Hi Res Amber	$129
USI 12" Green Hi-Hi Res	$129
USI 12" Amber Hi-Hi Res	$139
TAXAN 12" Green	$99
TAXAN 12" Amber	$109
TAXAN 13" RGB Color	$499
NEC JC 1216 RGB	$419
NEC JB 1205 Amber	$155

MODEMS

NOVATION

PC CAT, Crosstalk (1200) (baud)	$415
Smart Cat 103-212 1200	$415
212 Auto Cat	$575

ANCHOR MODEMS

(with power & cable)	
Mark 12 300-1200 baud	$319
Volksmodem 300 baud	$79

PRINTERS

STAR MICRONICS

FREE Freight & 6 Month Added Warranty	
GEMINI 10X Dot 120CPS	$287
GEMINI 15X Dot 120CPS	$497
DELTA 10X Dot 160CPS	$597
DELTA 15X Dot 160CPS	$747
POWER T DAISY 18CPS	$497
RADIX 10 Dot 200/50CPS	$847
RADIX 15 Dot 200/50CPS	$997

DISK DRIVES

CONCORDE DISK DRIVES

18M Sgl Sided Sgl Density	$289
18M Dbl Sided Dbl Density	$399

GRAPHICS TABLET

CHALKBOARD POWERPAD (with IBM Start Kit)	$149
Software Packages:	
Leonardo Logo	$39
Leo's Links	$27
Programmer's Kit	$19
BearJam	$25
KOALAPAD	$109

KENSINGTON MICROWARE

PC SAVER	$39
MICROSAVER	$59
BOTH ABOVE	$89

BOARDS

AST

ComboPlus, 64K S/P/C	$273
ComboPlus, 256K, S/P/C	$469
MegaPlus II, 64K, 2-S/P/C	$339
MegaPlus II, 256K, 2-S/P/C	$489
256K MegaPlus II Expander	$289
SixPakPlus, 64K, S/P/C	$289
SixPakPlus, 256K, S/P/C	$489
SixPakPlus, 384K, S/P/C	$589
I/O Plus II, 2S/P/C/G	$189
PCnet™ LAN Kit	$1284

PLANTRONICS

ColorPlus, 16 color brd w/Para Port	$369

CALL TOLL FREE
1-800-431-8697
602-968-9128

For Customer Service
Call: 602-955-3857

ORDERING & TERMS: Send cashier check, money order, personal/company checks allow 3 weeks bank clearance. VISA/MasterCard accepted. Provide phone number with order. SHIPPING: Software add $4.00 for first piece, add $1.00 each additional piece. Hardware add 3% or $10.00 whichever is greater. Returns must have authorization number (call 602-968 9128 for authorization number.) All returned merchandise subject to restocking fee and **must** come with **all** original packaging. No returns allowed after 30 days from shipping date. Prices are for cash. VISA and MasterCard add 3%. Prices subject to change without notice. All products subject to availability from manufacturers and/or suppliers. All prices in U.S. dollars. We pay shipping on backorders.

CIRCLE 194 ON READER SERVICE CARD

only serve to keep the honest people honest? Second, what about the functionality of the machine? Many copy-protected programs cannot be used with a hard disk or over a network, and some have severely limited capability for backup.

The copy protection argument could be viewed as a battle between Apple mentality and CP/M mentality. The first says to copy-protect anything and everything; use every available trick to drive the potential copier up a wall. The second says relax; let sales volume and higher prices cover the inevitable losses to piracy.

The PC clearly has a stronger allegiance to the CP/M world. After all, it evolved from 8-bit Intel technology and uses an operating system that started as an unabashed imitation of CP/M. The open architecture of the PC has been a prime factor in its success, and the ease of using software has been an immeasurable help. One of the things that makes the PC a pleasure to use is the way you can build your own system disks with the mix of programs that you want and avoid constantly changing disks and rebooting the system. MS-DOS's flexible, resident nature, like that of CP/M, is worlds away from the Apple mentality. Unfortunately, copy-protected software eliminates some or all of that flexibility.

We at *PC* are concemed about these approaches and continue to encourage manufacturers not to sacrifice functionality for protection—assuming that such a thing is possible. We wonder if software-based copy protection is any more effective than the 55-mph signs on our highways. If cars were equipped with poison darts in the steering columns, set to do in drivers who exceeded 55 by a predetermined amount, traffic laws would be fervently obeyed. Similarly, if protection schemes were hardware-based instead of software-based, there would be far fewer opportunities to violate a manufacturer's restrictions. We're not suggesting that your system electrocute you if the serial numbers don't match, only that hardware is better at some jobs than software.

Such a system, though, is simply not in the cards, or, more appropriately, the chips. The *only* foolproof means of copy protection is to relate it to execute-only microcode within the CPU chip. While such chips exist and are popular in many control and game applications, they have yet to be designed into any of the popular general-purpose microprocessor families. When Intel, Motorola, and Zilog (or their customers) decide it is time for serious copy protection, we'll get it.

The issues in litigation are not as simple as they might seem.

Legal Recourse

The issues in litigation are not as simple as they might seem. The manufacturers must first prove that their copyrights were, in fact, violated. How many corporations will invite the software manufacturer in for a look around? And how do you discern a legitimate backup copy from one intended for use on another machine? Second, license agreements that prescribe dire consequences for the end user while holding the manufacturer utterly blameless are unlikely to stand up in court. Some of these documents would be downright funny if the intent was not so earnest.

The lawsuits are inevitable. While the majority of legal actions to date have been against pirates at the reseller or distributor level, the next wave will be against the corporate violator. The biggest potential deterrent to corporate America is fear of embarrassment. Who, after all, wants to be hauled into court because he has repeatedly ripped off a $60 spelling checker? Smart CEOs and corporate attorneys will settle quickly and quietly. You can bet that they'll come down hard on the perpetrators, too.

For every smart CEO, though, there are dozens more who will never make the pages of *Fortune* or *Inc*. There will be court battles and countersuits. Some will be easily surmounted and others will drag on in court. But the manufacturers are determined to have their day. It won't be cheap, and it won't be dull. Stay tuned—and start looking for the purchase orders.

***

How did C get top billing on *PC*'s cover? Two ways.

First, C is the language, above all others, that has captured the imaginations of systems programmers everywhere. It has all the qualities necessary for success: conciseness, with an economy of expression that belies its power and flexibility; and functional, modular design, providing extensive facilities for reusable code and shared routines among many programs. Low-level functions allow interaction with the machine at the level usually reserved for assembly language. A rich set of operators for incrementing, loop control, and concatenation add to C's flexibility. Because it wasn't designed by a committee, C has tended to remain more standard than many other languages of similar vintage. (The people who don't get their pet features into the languages controlled by committees tend to put them in anyway and thus create renegade versions.)

C is also important as the foundation for Unix, the operating system created by Bell Labs for maximum programmer productivity. The perception of Unix as a good environment for end users is relatively new; Unix is notoriously unfriendly to users, especially occasional users. But the hierarchical file system, group security levels, and ease of file sharing are all ideas whose time has come for end-user microcomputing.

IBM has backed Unix and the microcomputer market will take another violent twist as the coattail riders scramble frantically to transport their applications to Unix and build in multiuser functionality. The true believers, who never cared whether IBM supported Unix or not, will just sit back and smile. ■

Plain Talk About Printers...

Dot Matrix

Printer compatability with the IBM-PC marches on: in eddition to the Okidata Microline Series with Plug-N-Play, the C. Itoh Prowntar now comes in e new version (the BPI) that'e compatible wifh the IBM-PC (see below). So what'a keeping the rest of the menufecturers?

ANADEX

B Series

Anadex printere ere fast, powerful & American made. Tha **9500B & 9501B** (120cps) heve 10, 12 & 17 cpi, double width, dot graphica (60 x 72 dpi); the **9501B** hes enhanced print modes.

The **9620B & 9625B** (200cps) have 10, 12 & 17 cpi, double width, dot graphics (72 x 72 dpi); the **9625B** hes a proportional font.

The **WP-6000** (276 cps) offers 10, 12 & 17 cpi, correspondence & proportional fonts, typefaces (Helvetica, Serifa, etc.), 154 x 144 dpi graphics. All **B Series** printers lieted have 136 columns, friction/tractor feed & a parallel interface.

9600B	$1119.88
9501B	$1119.88
9620B	$1199.88
9625B	$1299.88
WP-6000	$2349.88

C. ITOH

Prowriter
Prowriter BPI

C. Itoh'a **Prowriter** (120 cps) feeturea 10, 12, & 16 cpi, a proportional/ correspondence quality font, double etrike, double-width, sub/super scripfs, dot graphics (160 x 144 dpi) & friction/ tractor feed.

The **Prowriter BPI** offers code-compatability with IBM-PC block/dot graphica codes. & it hea all the feeturae of the Prowriter. A nice move.

Prowriter BPI	$459.88
Prowriter	$399.88

IDS/DATAPRODUCTS

P-480

The **P-480** (formerly MicroPrism) ie e nice general-purpose printer w/120 cps bi-directionel printing, 10, 12 & 17 cpi, e correspondence font, 64x84 dpi graphics, & friction/tractor feed. A nice product.

P-480	$429.88

MEMOTECH

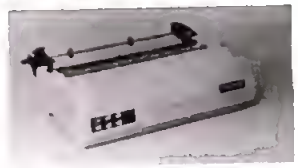
DMX-80

A dramatic black printer! The **DMX-80** (80 cps) features 10, 12 & 16 cpi, italics, double-width, half-width, enhanced/ bold print, dot graphics (120 x 144 dpi), friction/tractor feed. Comes with e 4,000,000 character ribbon. Epson code compatible in text mode (questionable in graphics). Quiet printing & e sharp design make it ideal for home or office. The **DMX-80** is serviced by Panasonic.

DMX-80	$389.88

MANNESMANN TALLY

MT-160 L/180 L
MT-Spirit



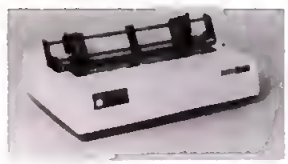
The **MT-160 L** (160 cps) features 10, 12, 17 & 20 cpi, a correspondence font, italics, enhanced/boldface print, double-width, sub/super scripts & underline, friction/tractor feed. Parallel & RS-232C interfaces standard. The **MT-180 L** is the 136 column version.

The **Spirit** (80 cps), Tally'a new, low cost draft printer, has 10, 12 & 17 cpi, italics, friction/tractor feed, & e unique square-wire printhead. 80 columns & parallel only.

MT-160 L	$849.88
MT-180 L	$849.88
MT-Spirit	$329.88

OKIDATA

Microline Series



The **Microline 92** (160 cps) is ideal for word processing. It featurea 10, 12 & 17 cpi, a correspondence font, double-width, emphasis/boldface, sub/super scripts, underlining, pin/friction feed (tractor is optionel on the **92**) & dot-addrassable graphics (120 x 144 dpi). The **93** is the 136 column version. Parallel interfaces are standard; the RS-232C interface is optional.

The **Microline 84** (132 col) is the Step 2 version, featuring 200 cps at 10, 12, & 17 cpi (w/double-width), all with e correspondance mode & dot addressable graphics. Parallel or RS-232C interfaces available.

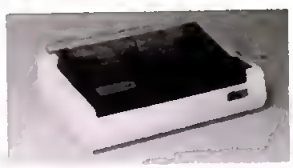
A new PROM called **PC Plug-n-Play** turns e **92, 93** or en **84** into en IBM-PC compatible printer, with full capabilities. You will sacrafice a few featurea (like 12 cpi) but the PROMe ere worth it if total compatibility is your goal.

The **Microline 82A** (120 cps) is e dete crunchers. Featuree 10 & 16 cpi (5/8 double-width). Dot-addrassable graphics are optionel. The **83A** is the 136 column version.

Microline Series	$CALL

STAR MICRONICS

Gemini 10X/15X
Delta 10/15
Radix 10/15



The **Gemini 10X** (120 cps) featurae 10, 12 & 17 cpi, italics, double-width, emphesis & boldface, sub/super scripts, underfining, graphics (120 x 144 dpi), e 1K buffer & friction/tractor feed. The **Gemini 15X** is the 132 column version.

The **Delta 10** (160 cps) features both parallel & RS-232C interfaces, & en 8K buffer, plus all the 10X featurea mentioned ebove. Tha **Delta 15** is a 136 column version.

The **Radix 10** (200 cps) features both parallel & RS-232C interfaces, e 16K buffer, plue all the 10X feeturea menfioned ebove. The **Radix 15** is e 136 column version.

Gemini 10X	$299.88
Gemini 15X	$419.88
Delta 10	$529.88
Delta 15	$669.88
Radix 10	$719.88
Radix 15	$839.88

Other Dot Matrix Printers We Carry

EPSON

RX/FX Series	$CALL

IDS/DATAPRODUCTS

Prism 132	$1239.88
w/4-color	$1669.88

INFORUNNER

Ritemen	$349.88

TOSHIBA

P-1350	$1759.88

Letter Quality

C. ITOH

A10 Starwriter
F10 Starwriter
F10 Printmaster

The C. Itoh **Starwriter** (40 cps) features 10 & 12 cpi, sub/super scripts, underlining, 6 & 8 lpi, Qume code & Diablo supplies. The **A-10 Starwriter** has the same specs, but it's slower (20 cps). The **Printmaster** has the same specs, but if prints faster (55 cps).

Both the **Tractor Feed** & the **Sheet Feeder** fit all three models.

A-10 Starwriter	$609.88
F-10 Starwriter	$1219.88
F-10 Printmaster	$1569.88
Tractor Feed	$289.88
Single Bin Sheet Feeder (A10/F10)	$919.88

NEC

Spinwriters

The new **2000** Series are slower (20 cps), but they've retained all the quality of the 3500/7700 Series. Usae the same thimblee & ribbone.

2010/2030	$979.88
2050	$999.88
3530	$1939.88
3550	$1699.88
2000/3500 Trector	$239.88
2000/3500 Sheet Feed	$CALL
7710/7730	$2159.88
7700 Tractor	$379.88
7700 Sheet Feed	$CALL

SILVER REED

EXP-550/500

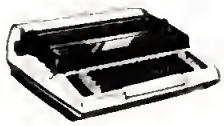
The Silver Reed **EXP-550** (17 cps) is e 132 column letter-quality printer with 10, 12 or 15 pitch, sub/superscript, underlining & ***true*** Diablo 1610 emulation, meking it compatible with most word processing software. It'a friction fed, & it featuree e page injector; an optionel tractor is also available.

The **EXP-500** (12 cps) is a 100 column letter-quality printer with tha same specs as the **EXP-550**, but slower &. without page inject or proportional spacing.

EXP-650 (Perallel)	$889.88
EXP-550 Tractor	$139.88
EXP-500 (Parellel)	$439.88
EXP-500 Tractor	$129.88

SMITH-CORONA

Messenger



The **Memory Correct III Messenger** (the full name) is ideal for the home or small office. It combines the features of an electric typewriter ***and*** a letter-quality printer. It features 12 cps, 3 pitches (10, 12 & 15), variable line spacing, 10 5" writing line, backspacing & auto-correction. It comes complete with parallel/serial interface.

Memory Correct III Messenger	$609.88

STAR MICRONICS

PowerType

The **PowerType** .17 cps) has 110 columns (11" print line), 10, 12 & 15 cpi, proportionel type, sub/superscripting, backspace/underlining & Diablo 620/ 830 code compatability. A nice printer for the price.

PowerType	$399.88

Other Letter Quality Printers We Carry

COMREX

CR-2	$509.88
CR-2 Tractor	$94.88
CR-2 Keyboard	$149.88

DIABLO

620 (RS-232C)	$999.88
630 (PC)	$1979.88

DTC

DTC 382Z	$CALL
StyleWriter	$CALL

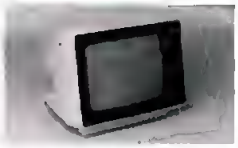
QUME

Sprint 11/Plus	$1539.88

Monitors

NEC

JB-1205M-A
JB-1201M-G



Slick design & slick specifications. The NEC **JB-1205M** is the ambar version. The **JB-1201M** is the green screen. Both offer 80 columns on a 12" diagonal screen, with an 18-20Mhz bandwidth & a crisp, clear diaplay.

JB-1205M (12" amber)..... **$175.88**
JB-1201M (12" green)..... **$159.88**

AMDEK

300G (12" green)..... **$145.88**
300A (12" amber)..... **$154.88**
310A (12" amber)..... **$199.88**

PRINCETON GRAPHICS

HX-12

The **HX-12** is ona of tha finest RGBs available tor the IBM PC. Features 16 colors, .31mm dot pitch (NEC'a tuba), 690 dots by 240 lines interlaced & 15MHz bandwidth. Comes with its own cable.

PGS haa two naw monitors: tha **SR-12**, aimilar to tha HX-12 but with 32 colors & trua 480 non-interlaacd resolution (without flicker), & the **Max-12** is an amber monitor with TTL input (IBM monochroma adaptar input), 18MHz bandwidth & 720 x 350 lines.

PGS HX-12..... **$499.88**
PGS SR-12..... **$CALL**
PGS Max-12..... **$CALL**

QUADRAM

QuadChrome

Tha **QuadChrome** has tha aama spec'a aa the HX-12. Same price too.

QuadChroma..... **$509.88**

Quadram Video Boards

QuadColor-1 ..... **$199.88**
QuadColor-2 ..... **$219.88**

USI/PARAQISE

MultiDisplay

Tha **Multi-Qisplay** combines both monochroma & color/graphica boards into a one-alot operation. It supports 32K graphics, with composita (NTSC), Medium-Raa RGB (300H x 200V) or TTL/monochrome (9x14 char & 8x8 char display)... *and* a parallel printer port.

MultiDisplay..... **$479.88**

Roland DG MB-121

We didn't discover theae per se...a cuatomar of ours raved about thair clarity, tha quality of workmanship & tha specs. We saw them at s trada show & sgreed. Ths **MB-121** features a 12" disgonal screen, 80 col x 25 lina display, sn 18MHz bandwidth, 640 dota horizontal by 200 lines vertical resolution & composite video input (NTSC) with an RCA cable included.

The **MB-121** comes in green (G) or amber (A) with s 90 degraa angla & non-glare surface. We expect a TTL-type monitor (IBM PC monochrome compatibla) shortly.

Roland DG MB-121G (12" Green)..... **$174.88**
Roland DG MB-121A (12" Amber)..... **$179.88**

PLANTRONICS

ColorPlus

Like the above, **ColorPlus** supports TTL/Monochroma or RGB output, & comaa with a parallel printer port. Sharp graphics program included.

ColorPlus..... **$439.88**

TECMAR

Graphics Master

The **Graphica Master** supports TTL/ Monochrome (720H x 700V), RGB (to 720H x 480V non-interlaced) or NTSC composita output. A 128K display buffar can ba used as systam mamory in low-raa modes.

Graphics Master..... **$579.88**

Modems

DC HAYES

Smartmodems

The ***Smartmodems*** are originate/ answer, auto dial/answer, tull/hatf duplex modems that run at either 300 or 300/1200 baud. Modular phona cable & power supoly included. An RS-232C cable is optional.

The **1200B** is a 300/1200 baud internal modem tor the PC. It includes all the features abova, plus ***Smartcom*** software. It requiras no additional RS-232C interface.

"Stack" Smartmodems
300 baud..... **$229.88**
300/1200 baud..... **$539.88**
1200B w/Softcom II **$489.88**

US ROBOTICS

Password
PC Modem
PC Modem 256

All thasa modams ara compact, LSI-dasigns with 300/1200 baud capability. Features inctude: originate/answer, direct connect, auto dial/answer, auto mode/ speed select, tull/hatt duplex (local echo) & audio phona lina monitor.

Tha **Password**, an axtarnal device, comaa with an RS-232C cable (specify mala or tamala DB-25), power supply & modular talaphona cable.

The **PC Modema** are plug-in boards that coma with 64 or 256K RAM, a parallel port & real-time clock with a battery back-up.

Password..... **$379.88**
PC Modam ..... **$CALL**
PC Modam 258..... **$CALL**

Peripherals

AST RESEARCH

MegaPlus II

The **MegaPlus** II has a parallel port, an RS-232C port, clock & memory to 256K. Software included.

64K MegaPlus..... **$309.88**
256K MegaPlus **$509.88**
256K MegaPak..... **$329.88**
Optional #2 RS-232C Port..... **$49.88**
Game Port **$49.88**

SixPak Plus

THa **Sixpak** has an RS-232C port, a parallel port, clock & memory to 384K. Software included. An optional game port is also avaitable.

64K Sixpak **$289.88**
256K SixPak **$469.88**
384K SixPak **$559.88**
Gama Port..... **$49.88**

QUADRAM

Quadboards

The **Quadboard** has an RS-232C port, a parallel port, a clock & memory to 256K (you can also gat your **Quadboard** "naked," with no memory installed). QuadSpool/Drive softwara is included with avary **Quadboard**, along with a one-year warranty.

Quadboard 0K..... **$224.88**
Quadboard 64K **$284.88**
Quadboard 258K..... **$434.88**

Quad 512 +

Quad 512+a have a singla RS-232C port on tham, & sockats tor up to 512K RAM. QuadSpool/Driva software is included.

Quad 512+ (64K)..... **$239.88**
Quad 512+ (256K) ..... **$CALL**
Quad 512+ (512K) ..... **$CALL**

Quad I/O

Quad I/O have a parallel port, an RS-232C port, game port & clock. Software included. An optional second RS-232C port is also available.

Quad I/O..... **$CALL**

Single Function Cards
Parallel Card w/cable..... **$89.88**
RS-232C Card..... **$89.88**
Clock/Calendar Card..... **$89.88**

QuadLink

Qu adLink is like having an Apple computer on one board, with 64K. **QuadLink** takes up only one slot. Add $20 tor Columbia MPC or Compaq computers whan you order.

QuadLink..... **$499.88**

Drives/Controllers

Tandon
(320K) Double-sided..... **$239.88**
Maynard Electronics
Disk Controller **$159.88**

Hard Disks

QuCeS External Hard Qiak
12MB..... **$2099.88**
20MB..... **$2339.88**
26MB..... **$2509.88**
Quadram Internat Hard Qiak
12MB..... **$CALL**
20MB..... **$CALL**

HD w/Tape Backup

12Mb Disk/Tape..... **$2919.88**
20Mb Disk/Tape..... **$3339.88**
35Mb Disk/Tape..... **$4889.88**
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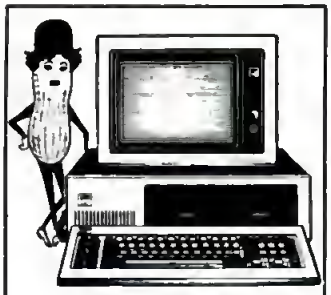

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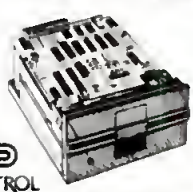

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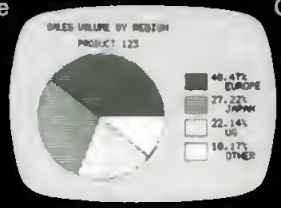

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CIRCLE 173 ON READER SERVICE CARD

Letters To PC

Science and Wizardry

I enjoyed C. Stuart Douglas' review of the *Palantir* word processor in your December issue ("The Wizardry Of Palantir," *PC*, Volume 2 Number 7). My department, the department of electrical engineering at the University of Mississippi, has shared Douglas' enthusiasm for this word processor since we began using it about a year ago. In a professional setting, its high price, $450, is quickly recovered through savings in operator training time that result from its elegant functional design.

Understandably, Douglas did not address the particular attractiveness of *Palantir* in the scientific environment. Its use of color to highlight print features, its provision for one-half line spacing, its avoidance of reverse indexing of the printer platen, and its facility for complex, user-written printer drivers make it especially well-suited to a technical mathematics setting. Most other microcomputer-based word processors provide for only a limited character set beyond the 96 ASCII characters, and their screen display techniques completely destroy line-to-line alignment of multiple line mathematical expressions.

Douglas wished that *Palantir* made better use of the PC's color capability. I feel, though, that *Palantir* uses color functionally rather than for pizazz. Indeed, we have just begun using release 1.15 of the MS-DOS version, which provides a blue background rather than a dark screen. The price of this pizazz is increased eye fatigue due to diminished contrast of characters

displayed in color against this blue background.

Palantir has often been criticized for its lack of hyphenation aids. This problem seems to be addressed neatly in version 1.15 and, one hopes, in the promised release 1.2.

L. Wilson Pearson
University of Mississippi

Proof of the Pudding

Please tell Stephen Manes to throw away his teddy bear and hug that blue-gray box with *Word Proof* in it ("Warding Off Evil Spells," *PC*, Volume 2 Number 7).

Word Proof does work with *WordStar* . . . at least the way I use it. In my writing, the important thing is getting the right words on paper, spelled correctly. With its on-line dictionary and thesaurus, *Word Proof* fills the bill admirably.

Once an article is written and proofed, it can be read by *WordStar* reformatted, underlined, and block-moved to my heart's content. Since the bulk of my writing is in a single format, with which I have become very comfortable over the years, I find that I can do most of my work with *Word Proof* alone. At $60, *Word Proof* is the best buy around.

Herb Poncher
Palos Verdes, California

Stephen Manes' review of IBM's latest little bundle, *Word Proof*, was right on the money. Without benefit of documentation, I had it up and running in minutes. The spelling checker worked perfectly, the screen painting seemed instantaneous, and the program even honored the case in which the misspelled word had been placed, replacing "ERRUR" with "ERROR" and "guuf" with "goof" with the flick of a key.

My greatest pleasure came with the built-in thesaurus. I took the Lord's Prayer as boilerplate (and I hope not in vain) and had the following version ready in minutes:

> Our Breeder, who art in Rapture, blessed be thy make. Thy Kingdom come, thy whim be done, down here as it is up yonder. Pass us this day our daily peck and condone us our breaches as we condone those that breach against us and steer us clear of lure, but save us from nasty, for Thine is the Kingdom and the Muscle and the Glitter for ever and ever. Thanks.

My only other prayer is to IBM. May it

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CONTROL DATA

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loosen up on its distribution policy and get products like *Word Proof* from the Big Blue yonder to end users like me without making us wait, for ever and ever, for ComputerLand to stock it.

Tony Kahn
Arlington, Massachusetts

Sitting Prettier

Your recent article on computer furniture ignores the most obvious and best source—office furniture dealers ("Sitting Pretty: A Computer Furniture Primer," *PC*, Volume 2 Number 7). In this pretty rural area we are served by three such dealers who are always glad to come to my place of business and discuss my needs or take an order. No need to even leave the office unless I want to.

Of course, you pay for all this service. To save some money you can order from mail-order houses, which I have also used and been satisfied with. These firms generally also sell paper, ribbons, diskettes, cables, and all sorts of accessories at attractive prices.

Niall MacDonagh
Rochester, New Hampshire

Crackpot, Eh?

Two articles in the December issue of your magazine, "MicroAstrology: Casting A Horoscope With Your PC" by Victor Rosenberg and "The PC Is A Leo" by Debbi Kempton-Smith, are extremely insulting to your readers' intelligence (*PC*, Volume 2 Number 7). While astrologers are usually very skilled liars, they have absolutely no ability to predict the future.

Astrology, a Babylonian religion handed down through the ancient Greeks, has no validity whatsoever. Its major premise, that the sun, moon, and planets of our solar system are gods who control the lives of each person from the moment of his or her birth, does not deserve any consideration in the twentieth century—certainly not in a computer magazine! Your readers deserve factual information, not crackpot nonsense. It is a poor reflection on your magazine's credibility that your editorial staff is so ignorant or so misinformed as to accept a silly superstition like astrology as fact. Please leave this sort of trash out of future issues—leave the screwball religion and fraudulent claims of supernormal powers to the *National Enquirer*.

John Lackland
Albert Lea, Minnesota

We are gods who control your life from the moment of your birth, see? So watch it.—The sun, moon, and planets of our solar system, c/o Debbi Kempton-Smith, New York City.

Telex Help

I have good news for Constantine P. Georiopoulis, whose plight was revealed in the letters column in the December issue ("A Tel-Expert," *PC*, Volume 2 Number 7). The solution to his problem with printing transmitted text is a device called a Freeport 232. This device supplies a second, bidirectional RS232 port to any terminal, including the IBM PC.

In a typical application, a serial printer is attached to the printer port so that all information displayed on the screen is simultaneously printed on the serial printer. In this configuration, the printer will control the receive rate from the source by sending an XOFF signal to the source when the printer buffer is full and an XON signal when it is empty. A switch on the Freeport 232 shuts off the extra port when hard copy is not required. I use this device with my Seequa Chameleon whenever I call a remote computer system. My printer is a C. Itoh 8510 Prowriter, but the Freeport 232 has been used with many terminals and printers.

I'd also like to express my thanks to *PC* for your policy of covering IBM PC compatibles. I find your articles very helpful in using my Chameleon.

Joseph W. Verzino
Dewitt, New York

No Strings Attached

I just finished reading Gregg Weissman's article, "Assigning Strings To Keys With PC-DOS 2.0" (*PC*, Volume 2 Number 6), and I thought it was terrific. I purchased PC-DOS 2.0 about a month ago; we use MS-DOS 2.0 on our computers at work, and I felt it would be less confusing if my PC had the "same" operating system. I have, of course, read the documentation, including the section on ANSI.SYS, but I never quite got around to figuring out how to use ANSI.SYS. There was always something more important to do with the computer, and I didn't really need to redefine the keyboard.

Since Weissman's article clearly explained how to define the function keys, I decided that now was the time. With little effort I was able to reprogram my function keys to my liking, and now I wonder why I didn't do it before. DOS is much faster now that I can easily execute the frequently used commands. I also changed the reverse apostrophe, which I never use, to the colon, which I use all the time.

I am very grateful to Weissman for his help in explaining ANSI.SYS. He assumed that the reader was not an idiot, and his article was clear and useful.

Joseph R. Stimers
Los Angeles, California

Is It Live or Is It Memex?

Victor Rosenberg has written an interesting article ("Library Automation Reaches Out To The PC," *PC*, Volume 2 Number 6). It is of particular interest to me because of the author's mention of Dr. Vannevar Bush and the memex, about which Bush wrote so eloquently in his article "As We May Think" (*Atlantic Monthly*, July 1945). Bush, who had been president of the Corporation of the Massachusetts Institute of Technology, was serving as the World War II head of the Office of Scientific Research and Development when he wrote "As We May Think." As the war was winding down, he sought to identify a postwar task fit for the scientific talent that had contributed so much to the Allied war effort. The creation of the memex was the task he deemed most suit-

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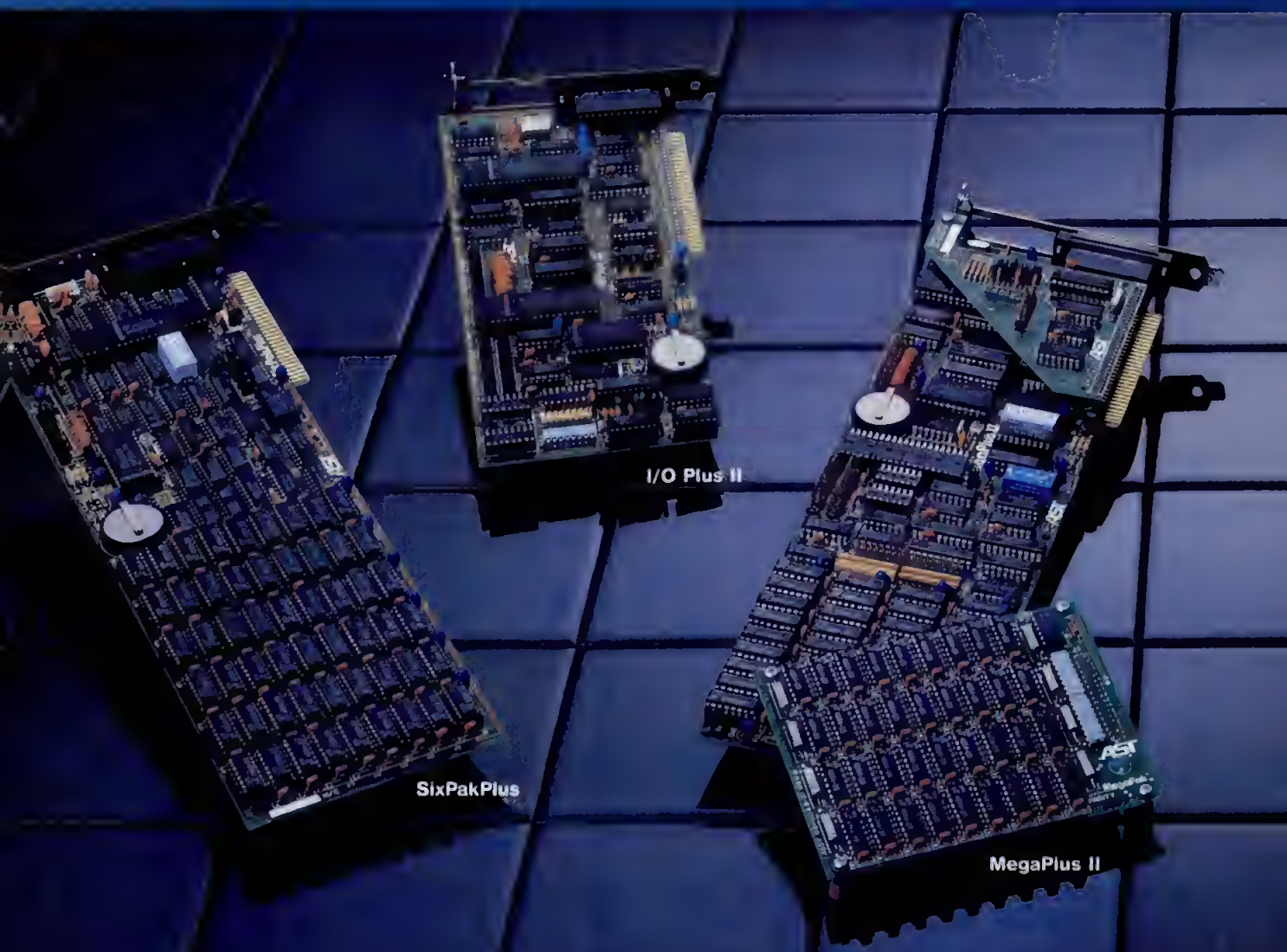

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MP Expansion	X						

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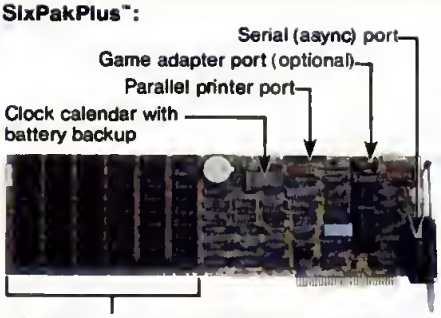
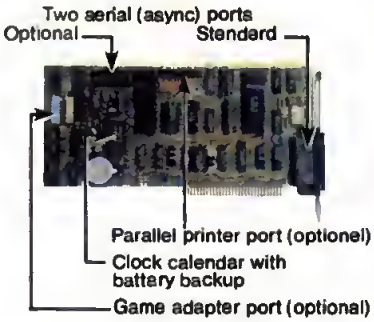
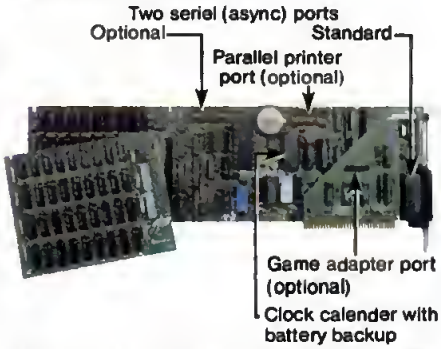


64K-384K of parity checked memory. Added to a PC or XT with a fully populated 256K system board, the SixPakPlus can bring the system memory to 640K, the maximum addressable user memory.

I/O Plus II™:

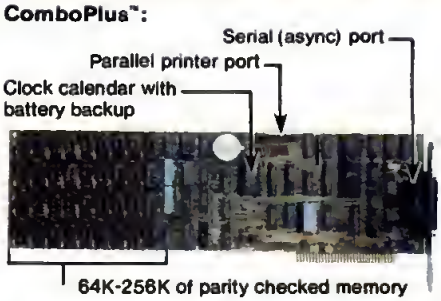


MagaPlus II™:



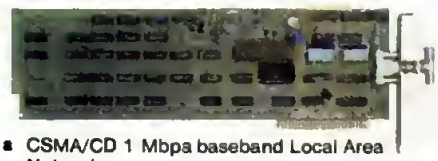
64K-512K of parity checked memory. The basic card expands to 256K, and with the MegaPak extension expands to an additional 128K or 256K of parity checked memory.

ComboPlus™:



MP Expansion Memory:

AST-PCnet™:



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Folded edge of the page

GbsSlipSheet-001

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3. Slice the folded edge
4. Close the page and slip-sheet

1. Follow instructions on the other side

Inverted Back

GbsFlipBack-001B

Back

1. Follow instructions on the other side

• **Parallel Ports** — The parallel port is used for connecting a parallel printer to your PC. A parallel printer typically uses a dot-matrix output which is suitable for high-speed draft quality printouts. The PC allows for the installation of up to three parallel ports.

• **Clock-Calendar** — With the on board battery, the clock-calendar feature will maintain the correct date and time, even when the PC is turned off. This feature eliminates the need for typing in this information each time you power up your computer.

• **Game Adapter** — The game adapter port allows you to connect an IBM-type joystick to your PC so you can play the multitude of arcade-quality games which take full advantage of the PC's graphic capabilities. Or you can use the joystick input for other applications by writing your own programs.

• **SuperPak™** — Every AST Research Multifunction Board comes with an AST SuperPak diskette containing programs for setting and accessing the clock, as well as SuperDrive™ and SuperSpool™, the most powerful RAM disk and print spooler available for PC-DOS. With SuperDrive you can use your PC's memory for simulating one to four floppy drives, from 20K to 360K each. SuperSpool allows you to set aside memory (from 4K to 512K) as a print buffer; SuperSpool sends output to the printer in the background while you execute your program in the foreground. With SuperDrive and SuperSpool, you can significantly improve your PC's operating speed.

• **Proven Compatibility** — All AST Research hardware and software products are 100% compatible with all versions of the PC and PC-XT as well as the Compaq and other PC look-alikes, and are 100% compatible with PC-DOS 1.1 and 2.0.

• **Warranty** — All AST Research products are backed with a one year limited warranty covering parts and labor with an optional paid second year warranty available.

Of course, all AST Research Multifunction Boards come with the **AST "PLUS,"** our unsurpassed reputation for quality, reliability, after-the-sale support, and overall design excellence which give our products the best price/performance ratio in the industry!

able. (Unlike Rosenberg, I would not call the task "Jules Verne-like.")

In "As We May Think," Bush (who was, incidentally, the inventor of one of our early computing machines, the digital differential analyzer) described the memex as "an enlarged, intimate supplement to [a user's] memory . . . . The process of tying things together is the important thing . . . . Thus, science may implement the ways in which man produces, stores, and consults the record of the [human] race."

Bush wrote at length about "tying things together;" he called the idea "trails of association," by which he meant establishing the connections between and among subjects in a collection of information-containing objects (ICO). More important than his coining of the name—more important, I believe, than the idea itself—was his description of the role of the user of a collection in discovering and establishing the trails of association. Trails were not to be cast in stone by some so-called expert at the time an ICO was added to a collection; rather, the establishment of the connections was to be the ongoing task of the people who made use of the collection.

These connections or trails of association can be very subjective or personal, even changing with users and the ages in which users find themselves. What Bush saw more clearly than his predecessors, contemporaries, and even some of his heirs, was that information collections are dynamic, their dynamics nurtured by successive generations of users.

No one who reads "As We May Think" could mistake a major goal of memex: To provide an individual with the means to organize and control the information in which he is interested. Each individual was to be allowed by memex to contribute to a collection of information what he learned about the collection whenever he had recourse to it. These contributions were to be cumulative; thus, every user of a collection could know, in effect, not just what every other user of the collection knew, not just what his contemporaries knew, not just what the reference librarians knew, but what was known to all his antecedents! This is a vision that should excite everyone who reads Bush's words.

My experience, and I imagine, that of every other user of a library, is that librarians regard such ideas as heresy. Perhaps that is why Rosenberg neglected to mention what I believe to be the central idea of "As We May Think": "Imagine the chaos that would result if we let every Tom, Dick, and Harry make entries in *our* card catalog," I have been told by librarians since 1957, when I first mentioned the idea. In my view, which is Bush's, libraries and their patrons would be immensely enriched if users were allowed to contribute to the card catalogs.

I was so impressed by Bush's ideas when I first read "As We May Think" that I invented a "primitive technology"—pencil and paper—memex for my own personal "library" of books, articles, notes, and correspondence. Even in 1962, I would have preferred to use a computer, but the manager of my employer's computer center told me I should anticipate that keypunching might involve a wait of 24 hours or so, and that it would take another 24 to 48 hours to fulfill my search requests. When I had a client on the phone asking a question, I wanted an answer immediately. My pencil and paper memex often provided me with answers in minutes. Many of my colleagues have used my memex, both to find things and to enrich my collection by contributing information to it.

Today I make my living helping people improve their abilities to organize and control the information in which they are interested. I still employ primitive technology for those who prefer it. For those who prefer high tech, much of the functionality "Jules-Verned" by Vannevar Bush in 1945 is available to users of personal computers like the IBM PC. With my assistance and with mNemoDex, the name by which my memex is known in commerce, an individual can construct long-term "external" memory for himself and his organization to preserve information and ideas that can exist even beyond the tenure of that individual's association with the collection or management of the ICOs and their content. Anyone can know what everyone knows or has ever known.

When libraries can serve their patrons as Bush described, librarians will have taken a giant step. That is a far cry from installing coin-operated PCs on the premises, however useful their patrons find such services.

Robert M. Gordon
Los Angeles, California

The Solar PC

I am a professional architectural engineer and I am in the process of designing a solar home for my family. I had read some time ago that an Apple computer could be used to control the temperature control systems in a solar home. Has such an energy management system been designed for the IBM PC?

I want to use my PC to open and close motor-controlled air dampers and piping valves based on temperature and air-flow sensor input. I will also be looking at ways to use the PC to control other home systems such as lighting and security.

R. Ted Krasnesky
Lake Zurich, Illinois

We invite readers who have such information to let us pass the word on.—Ed.

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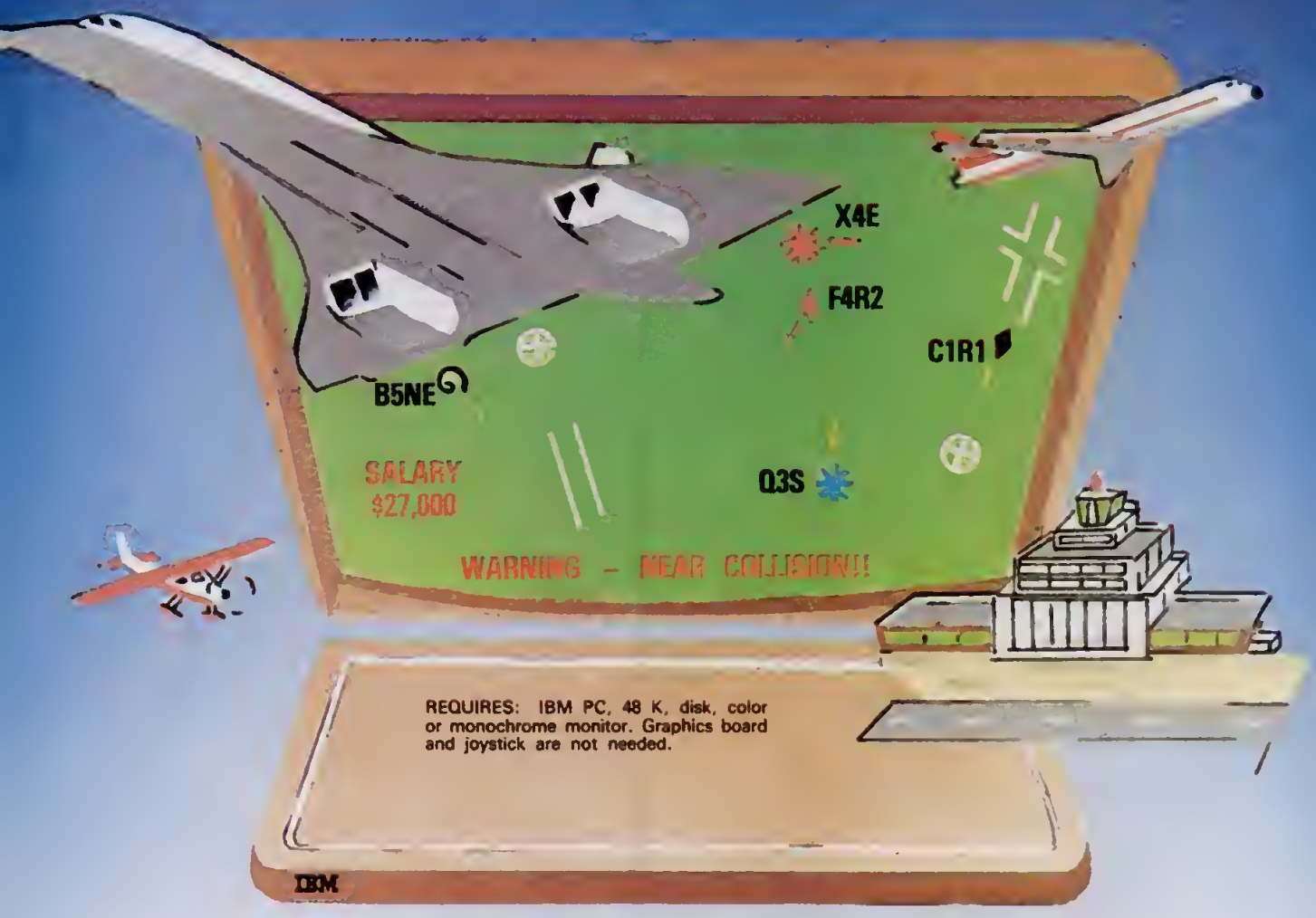

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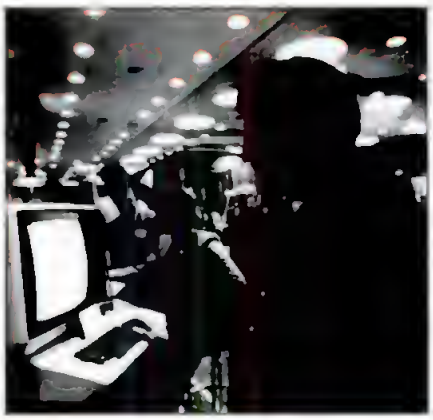

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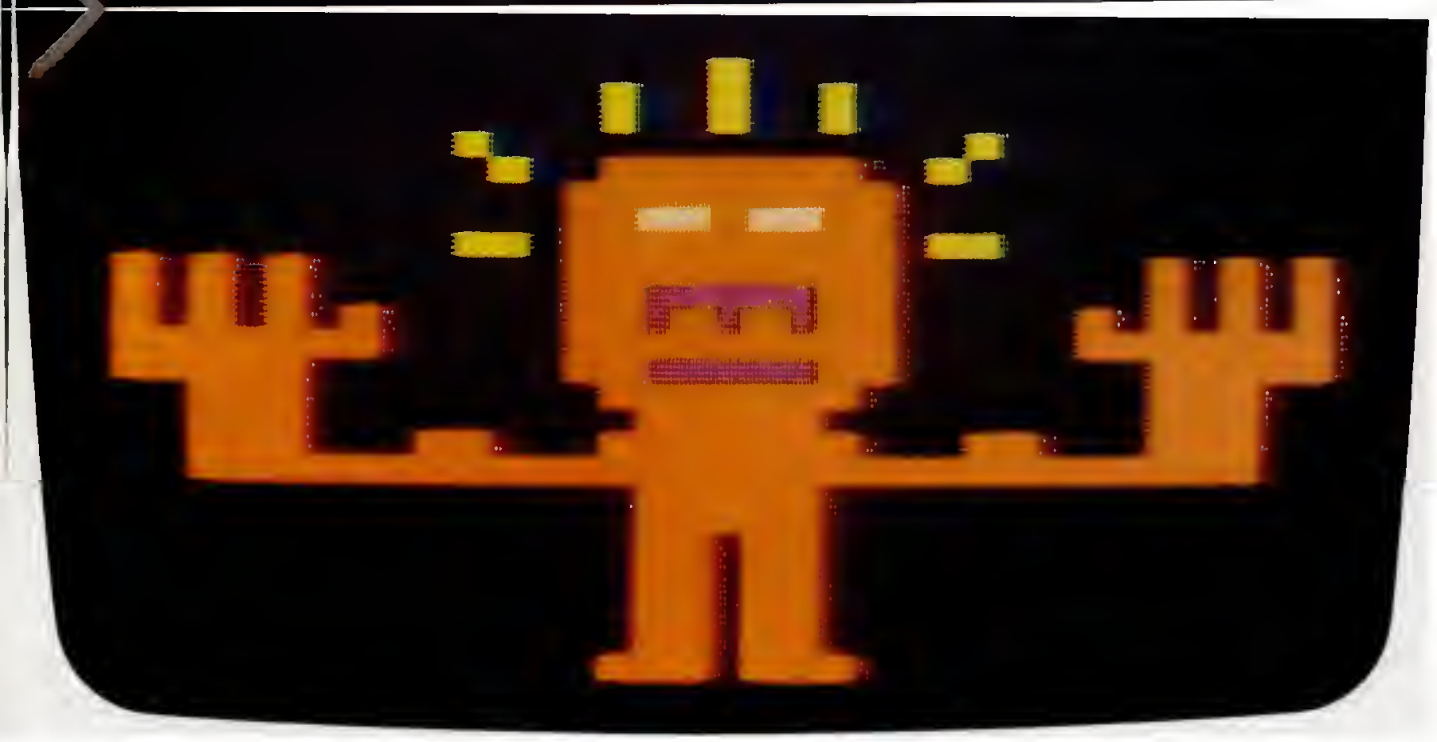

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Phantom Ruling From The IRS

A recent ruling that threatens to deny federal tax-exempt status and its privileges for PC user groups is the latest jolt in their continuing tug-of-war with the Internal Revenue Service.

Just when we thought it was safe—nay, desirable—to chat with the IRS about federal tax exemptions for our user groups, pow!

Now the IRS has come out with Revenue Ruling 83-164, a policy pronouncement that a group formed around "users of one particular brand of computer" is not a tax-exempt organization because it "helps to provide a competitive advantage" to a single manufacturer.

Why should members of PC user groups care? Mainly because of the implications this latest salvo from the IRS national office has for the hundreds of computer user groups across the country that are organized around particular computers. These implications could adversely affect not only user groups formed around the IBM PC and compatibles, but also those for Apples or Osbornes or any other brand.

This negative new ruling is not just one of the IRS's private rulings, like the one issued to the Capital PC User Group. That ruling (see "A Taxing Question: Exemptions for User Groups," *PC*, Volume 3 Number 3) granted tax exemption to the Washington, D.C. club. But alas, it is only a private ruling that is limited to that group, and no other organization is entitled to cite it as a precedent.

By contrast, Revenue Ruling 83-164 is the most formal level of published ruling;

Laura Lou Meadows

it states a general policy that is applicable to everybody. It is designed as a guideline for individual private rulings by all local IRS offices and is made public expressly so taxpayers will know what the feds do and do not approve of.

Aren't the results of these two actions conflicting? Does the left hand of the IRS know what the right hand is writing? Well, no and yes.

Upon closer examination, we see that Revenue Ruling 83-164 denies tax exempt status as a *business league* to a group that "directs its activities to users of computers made by one manufacturer." The private ruling for the Capital PC User Group grants it tax exemption as a *social welfare* organization.

So there are two distinctions here. First, the exemption granted to a social welfare organization is based on different standards than those for a business league. Second, the Capital PC User Group, although initially focused on IBM PC users, has evolved to the point where it does not restrict the scope of its programs and activities to the products of a single manufacturer.

Tied to One Brand

Once you lay down your money for a computer, you become the machine's economic hostage. Your interest in the computer user group now is to find out how to make your investment perform as promised. You also want to learn about the ever-increasing array of components, replacement parts, peripherals, and software that is compatible with your computer.

Today, two major types of electronic architecture or internal structure dominate the market. These two structures are best exemplified by the 8-bit Apple using the CP/M operating system and the 16-bit IBM PC using MS-DOS.

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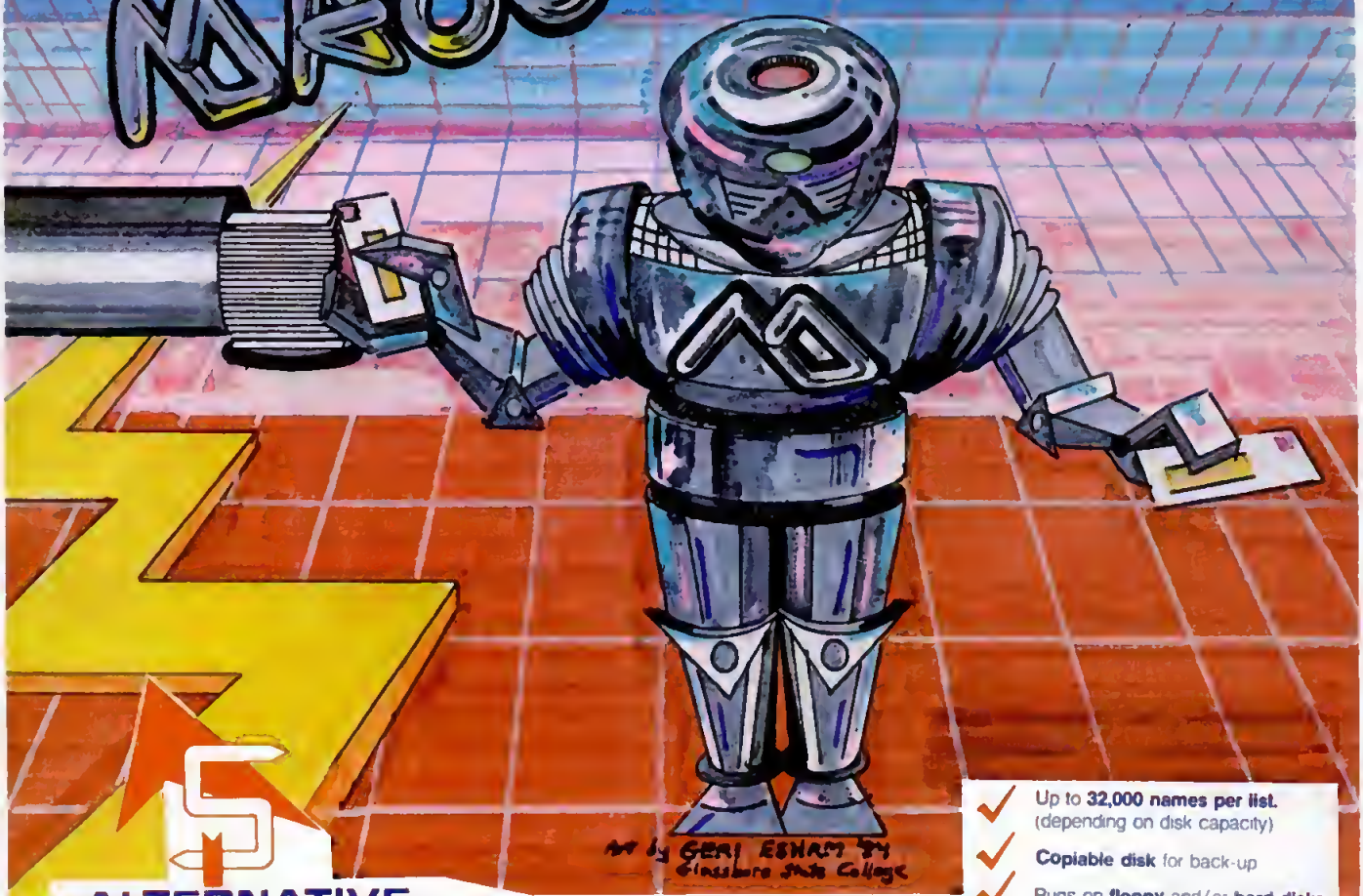

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make the PC realize its full potential. All of these items had to be bought from other manufacturers.

The user group was one of the few places where the computer novice could get help in selecting and working with the peripherals and software he needed to transform an IBM PC and the rest of the pieces into a coherent system.

Hard on the heels of IBM's success with its PC, other companies came out with computers with very similar internal structure, purporting to be compatible with the IBM PC and programs written for it. The big job is sorting out what is readily compatible, what is irredeemably incompatible, and what can be coaxed into compatibility if only you can find the magic incantation.

The distinct set of problems connected with each of the major kinds of internal architecture, often indicated simply by using the name of the leading manufacturer (such as Apple or IBM) in the name of the club, became the flag around which each group rallied. Such a user group might be named after a brand, but its activities usually are tied to an electronic structure and address the compatible products of many manufacturers.

What's the Difference?

In Revenue Ruling 83-164, the nonprofit organization was disqualified as a tax-exempt business league because its purpose was to develop and disseminate information pertaining to the electronic data processing equipment manufactured by a single company. Membership was made up primarily of businesses that owned or leased that company's equipment, although membership was also open to businesses that did not use that company's equipment.

Curiously enough, the IRS had ruled a decade earlier in Revenue Ruling 74-147 that a nonprofit organization representing diversified businesses that used "digital computers produced by various manufacturers" *did* qualify as a tax-exempt business league. The purpose of that hypothetical computer group was "to provide a forum for the exchange of information that will lead to the more efficient utilization of computers by its members and other interested users, and thus improve the overall efficiency of the business operations of each."

Does the left hand of the IRS know what the right hand is writing?

What's the difference? Revenue Ruling 83-164 distinguishes the group in Revenue Ruling 74-147 on the grounds that it directed its activities to users of computers made by "diverse and competing manufacturers," benefiting a whole line of computer businesses, while the group in the newest ruling, by directing its activities to the users of a single brand of computers, gives an advantage to the customers of that brand at the expense of its competitors. IRS lesson: If you are improving conditions in a whole line of business across the board, you can be a tax-exempt business league. If you are helping out just one brand or manufacturer, you can't.

A Rose by Any Other Name

What should you do if you are like half the user groups listed in this magazine who have IBM in their names, and you are interested in obtaining federal tax-exempt status?

First, review your purposes and activities to see if your group in fact serves users of IBM-compatible machines as well as other products from a variety of manufacturers.

If so, you could take on the task of explaining to the IRS the distinction between the hypothetical group in Revenue Ruling 83-164 and your group. Or you could change its name, deleting IBM and making it more generic and accurate. You may need to do both.

If your computer club operates in the red or breaks even, it may not have any net income that would be taxable in the absence of an exemption.

Still, it might be useful to have a federal tax exemption if your activities are on the rise and you anticipate income in the future. It can be useful too in dealing with local government agencies in obtaining meeting places and corralling other support for your activities.

What may be of greater immediate benefit is status under your state law as a tax-exempt organization, which not only carries local benefits—usually income and sales tax exemption—but is also a helpful factor in applying for the federal tax exemption. According to where your group operates, the state standards for tax exemption may be more lenient (likely) or more stringent (conceivable) but, in most cases, different.

Categories for Exempt Status

The Internal Revenue Code lists about two dozen categories for tax-exempt organizations. The four categories under Section 501(c) of the Code where a computer user group is most likely to fit are educational or scientific organization, social welfare organization, business league, and social club.

The threshold restriction needed to bring a user group under any of these categories is that "no part of the net earnings . . . inures to the benefit of any private shareholder or individual."

An educational or scientific organization under Section 501(c)(3) is the only category that allows gifts to the group to be deducted as charitable contributions on the tax return of the giver. However, many of the contributions to a user group of cash or tangible property may also be deductible as business expenses of the giver, so classification as educational or scientific may not be essential to make the group flourish. ■

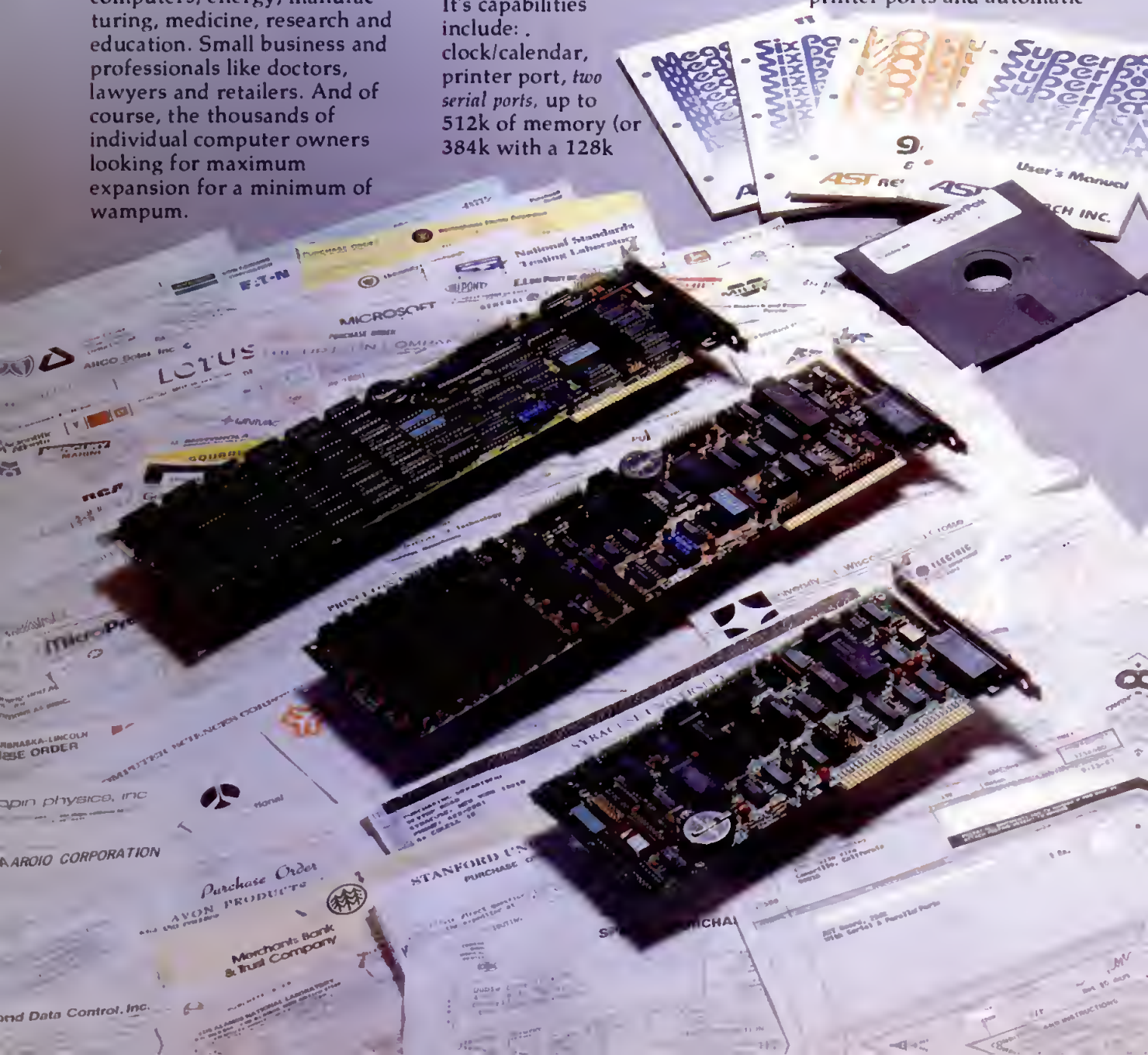
Laura Meadows has been a tax lawyer for the past 21 years. She practices law from her home with the help of an IBM PC.

How the Big Guys Exp

When you are going to expand a thousand PC's you want to get it right. Fact is, if your going to expand one PC you want to get it right. Selection of a supplier for an expansion board is more than guess work. Take a look at the organizations that buy from Qubie'. World leaders in computers, energy, manufacturing, medicine, research and education. Small business and professionals like doctors, lawyers and retailers. And of course, the thousands of individual computer owners looking for maximum expansion for a minimum of wampum.

THE PEOPLE'S CHOICE

You can't gather an impressive list of customers without impressive products. You just have to be impressed with **MegaPlus II**™ and **SixPakPlus**™ from AST Research. **MegaPlus II**™ is the most flexible expansion product available for the PC. It's capabilities include: . clock/calendar, printer port, *two serial ports*, up to 512k of memory (or 384k with a 128k **MegaPak**™), and a game port. It's new brother, **SixPakPlus**™, is the perfect match for the new XT, and PC with 256k internal capacity. It's features include: clock/calendar, printer port, serial port, memory up to 384k, and game port. And **I/O-Plus II**™ is the answer for those who need serial and printer ports and automatic



and their PC's & XT's

i:ime and date loading, but lalready have their memory needs satisfied. All three include comprehensive manuals which are clearly laid out so even the novice computer owner can install his own board. Also included is the AST **SuperPak™** software which includes electronic disk emulation and printer spooling software. These programs were picked by the readers of PC WORLD as the best available. It's no wonder AST has become the #1 supplier of enhancements for IBM PC and XT.

MegaPlus II™
$229 includes:
- Clock/calendar with battery back-up
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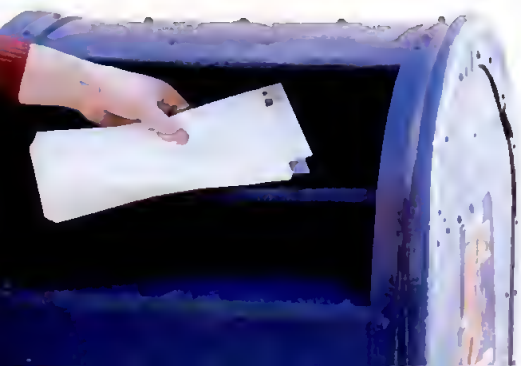

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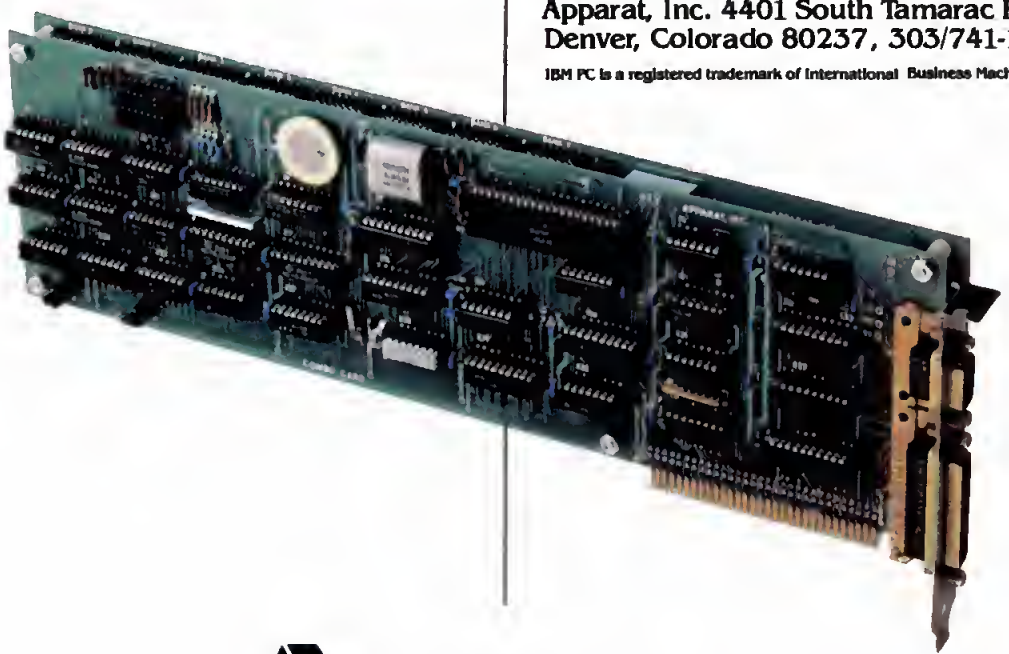

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CIRCLE 118 ON READER SERVICE CARD

Unearthing The PCjr's Secrets

In his wanderings through the PCjr Technical Manual, Norton looks in some corners, opens some closets, and turns up several interesting quirks about IBM's newest machine.

I love to break my promises when I get a chance to do something better than what I originally promised. In the last issue, we dug into some of the practical ramifications of subdirectories, and I promised more on that subject in this issue. I'm going to put off that discussion for another issue, however, and explore some interesting things I've uncovered in the *Technical Reference for the PC*jr, which IBM has recently made available. Let's begin with the PC*jr*'s memory and the prospects for expanding it beyond its official limit of 128K. Many people seem to be quite confused about this question. Here's where the confusion arises. The IBM literature states that the PC*jr* takes a maximum of 128K. But the PC*jr* has an I/O channel on its side, which is equivalent to the expansion slots on the PC and XT, where more memory can be added. When IBM's technicians were asked about this I/O channel, they said, yes, it includes memory addressing; so, yes, more memory can be added to the PC*jr*. So what is the answer? Can we add more memory or not?

The raw answer is yes; we can add more memory to the PC*jr* in exactly the same way as we can for the PC and XT. But the refined answer is that we can't use this memory in the ordinary way. The explanation is somewhat complicated.

Peter Norton

Everything that appears on our computer's display screens is stored in memory. In addition the computer must set aside some memory for the screen. In the PC and XT, the display adapter card contains all the memory that the screen needs; for the color-graphics adapter 16K is required. A special block of memory address space is set aside for the display memory to use. On a PC or XT all the ordinary memory possible (as much as 640K), is located below the memory addresses set aside for display. In the PC*jr*, the design is a little different.

The PC*jr* gets its display memory by borrowing from its regular RAM. Whether the PC*jr* has 64K or 128K, a portion at the top is set aside for the display screen. This design is the reason why a 128K PC*jr* has less usable memory than a 128K PC—programs that barely fit into a 128K PC are too large for a 128K PC*jr*.

Now comes the interesting part. Apparently, using its I/O channel we can add more memory (up to 640K) to the PC*jr* if we want to. But, unless I've misunderstood the PC*jr*'s technical manuals, the display memory can't be moved up to a higher memory location. So even if we put lots of extra memory on a PC*jr*, the memory that the display uses will still be located at the top of the first 128K. If we tried to use the PC*jr*'s ordinary memory with memory added above it, we'd find that the memory had a hole in it—a 16K hole where the display screen's memory is.

The result of this arrangement is that any extra memory beyond 128K that we add to the PC*jr* can only be used in certain ways—for example, by a RAM disk, or electronic memory disk emulator. But extra memory can't be used as general purpose program memory; for one thing, DOS isn't prepared to deal with memory that has a hole in it.

Actually, adding memory for a RAM disk to a PC*jr* would be a real boon—the main drawback of the PC*jr* is its lack of a second disk drive and its slow access to the one that is there. When I compiled a program with the SBB-Pascal compiler, the PC*jr* took almost exactly twice as long as a PC did. The slow speed is a result of the

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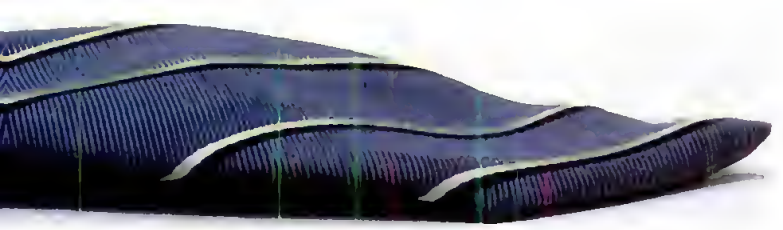

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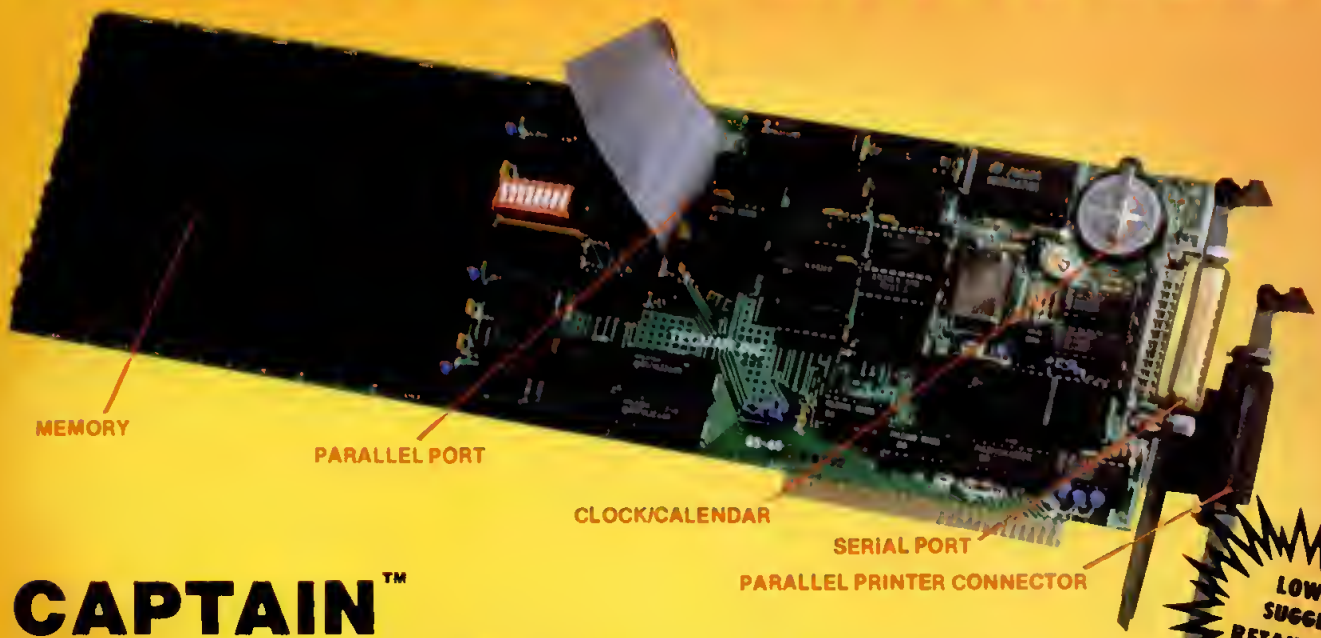

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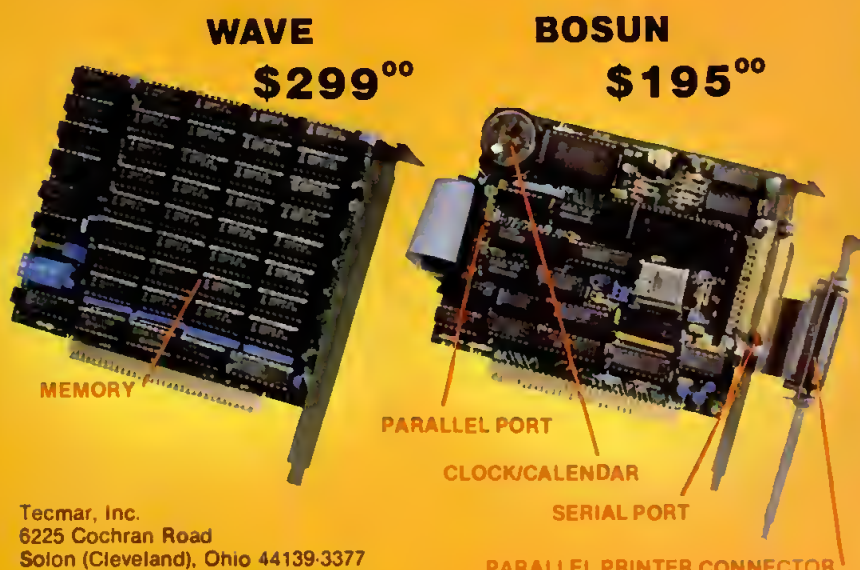

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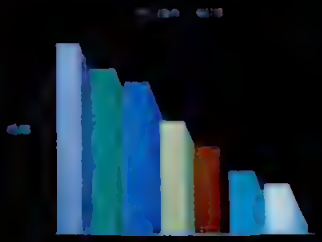

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way the disk is controlled. Adding memory to the PC*jr* for a RAM disk is a terrific idea, but unfortunately, simply adding more memory won't give us more general-purpose memory, the way it does for the PC and XT.

Speed

While we are discussing the PC*jr*'s speed, let's explore that subject a bit. Even though the PC*jr* has the same microprocessor as the PC and runs at the same clock speed, the PC*jr* is inherently slower for two reasons. First, since they use the same memory circuits, the processor and the display screen compete for memory cycles. The display gets two out of every six memory cycles, and the processor gets the other four. Since the processor doesn't need the memory all the time, this cycling slows down the PC*jr*'s computing speed by only about 15 to 20 percent.

The other reason the PC*jr* is slower than the PC is that its processor has to do work that, in the PC and XT, is handled by support circuitry. Both the keyboard and the disk drive require much more attention from the PC*jr*'s processor than they do from those of the PC and XT. In the case of the keyboard it isn't too much extra work, but for the diskette, it's quite a bit. When the PC*jr*'s disk drive is in use, its processor is kept busy looking after it.

We probably won't notice the speed difference most of the time, except during tasks that keep the computer busy. The Pascal programs that I ran are probably typical of long, busy computer work. In each trial that I ran, the PC*jr* took almost exactly twice as long as the PC.

Another interesting tidbit about the speed of the PC*jr*'s disk drive: All the IBM personal computers use a table, called the "disk base." This controls, among other factors, the time allowed for the disk drive to move its read-write head from track to track, and for the motor to reach full speed when the drive starts up.

IBM designed the disk base table so that it could be changed. Every release of DOS since 1.1 has modified this table.

The PC*jr* may look simple, but under that smooth skin it possesses flexibility that allows it to change in ways even the PC and XT can't match.

This is why our disk drives worked much slower under DOS 1.0 than they have since. Even though we can change this table, an interesting override is built into the PC*jr*. In its ROM-BIOS (a built in control program), special programming ensures that we don't change the diskette start-up time to anything less than a half-a-second.

> The PCjr's software cartridge interface design allows a cartridge to temporarily replace the ROM-BIOS.

A Cartridge ROM-BIOS

A third interesting item from the PC*jr* *Technical Reference* concerns plug-in software cartridges. The ROM-BIOS of all IBM personal computers is stored in permanent, read-only memory at the top of the address space. In the PC and XT, there is no practical way to make changes to the ROM-BIOS, short of completely and permanently replacing it. This is not true for our new PC*jr*.

The PC*jr*'s software cartridge interface design allows a cartridge to temporarily replace the ROM-BIOS. Each software cartridge has built into it the memory address where its programs are to be located. This address would be in a range of addresses set aside especially for cartridges. But a cartridge can also address itself right on top of the built-in ROM-BIOS, thereby overriding it.

This exciting bit of news means that clever people can write a new BIOS that changes the character of the PC*jr* in many ways. People don't do this sort of thing with the PC and XT, because a new BIOS means a permanent change to the computer. With the PC*jr*, however, a new BIOS that turns our PC*jr*s into very different machines can be plugged in or removed any time we want. The possibilities are staggering. I'm looking forward to seeing some of them realized. ■

COVER STORY/LESLIE BAKER & NAT SAKOWSKI

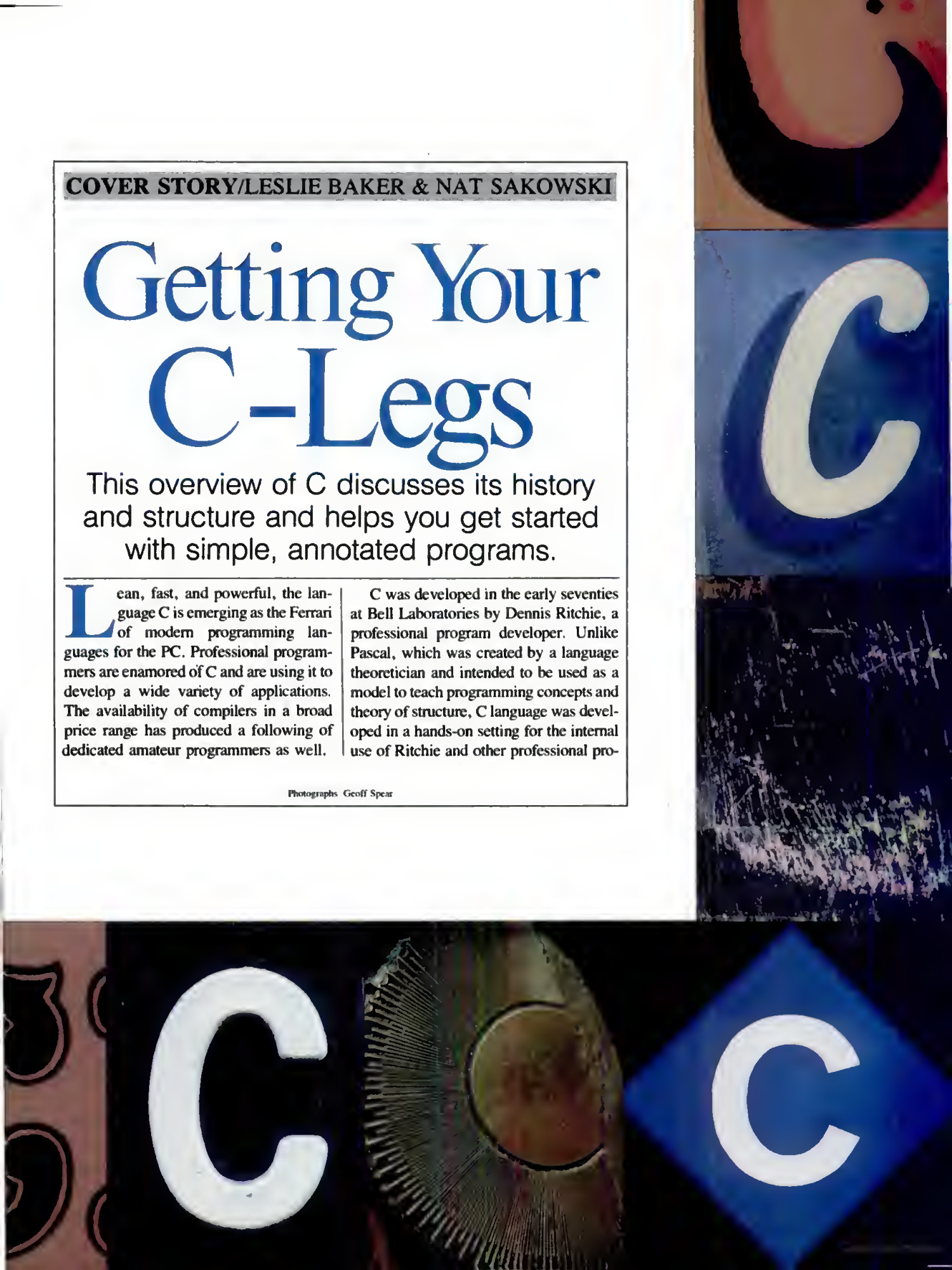
Getting Your C-Legs

This overview of C discusses its history and structure and helps you get started with simple, annotated programs.

Lean, fast, and powerful, the language C is emerging as the Ferrari of modern programming languages for the PC. Professional programmers are enamored of C and are using it to develop a wide variety of applications. The availability of compilers in a broad price range has produced a following of dedicated amateur programmers as well.

C was developed in the early seventies at Bell Laboratories by Dennis Ritchie, a professional program developer. Unlike Pascal, which was created by a language theoretician and intended to be used as a model to teach programming concepts and theory of structure, C language was developed in a hands-on setting for the internal use of Ritchie and other professional pro-

Photographs Geoff Spear



grammers. Only much later was the language documented and made available to the public.

C takes some getting used to. It's made up of symbols and conventions designed to produce programming code that communicates effectively with your machine. These symbols often seem cryptic on the printed page, where we are accustomed to reading text material in English. Often a C program will look like wartime code and appear to need deciphering, but don't be put off by its looks; it is a great shorthand once you get used to it.

Brace Yourself

When you're actually sitting at the keyboard, typing a curly brace to start a program is much easier than typing the command BEGIN. Typing the closing brace is easier than typing the command END. Condensed symbols like these economize on keying-in time and compile more quickly than statements containing multiple alphanumeric characters. Knowing what the C symbols mean will let you represent large chunks of information with just a few signs. Figure 1 is an example of a simple program written in C.

In C coding, a group of statements, called a block, is isolated from its neighboring blocks by braces. C is a hybrid language; it has many of the attributes of high-level programming languages and, in addition, features that let you work close to the machine level, even enabling bit manipulation. You can thus code high-level functions, assignments, and statements in one block, put it in the "isolation ward," and proceed to an adjoining low-level block. These blocks will never corrupt one another. When you finish with individual units you can join them together into a smoothly running program.

Each procedure in C is called a function, and functions are combined into larger modules. The language encourages you to experiment and create your own functions, which you can store in the C library and later combine with newly developed routines at link time.

Portability is one factor that has made C a great favorite with programmers.

Slicing It Up

C is built on a structured programming model, a concept that offers the options of isolating or merging parts of the program. Structured programming techniques can be explained with a salami analogy: Instead of trying to tackle a giant project all at once, you keep slicing it, like a salami, into chewable sections. In other words, you separate the elements of the project and work on one small unit at a time, documenting and debugging each before going on to the next. Little by little the slices or functions pile up and are finally integrated into one complex program.

C has a rich vocabulary of data types to describe the variables or data elements. These include `char` (character) or 1-byte variables; short, 2-byte variables; and 4-byte variables called doubles. The `float` data type holds at least 6 decimal digits, and the double data type holds at least 15. When designing a program, it's usually important to consider how much memory you'll need for each data type. If you specify too little, you sacrifice precision, but if you specify too much your program will run slowly because of memory location searches.

C's data typing is considered looser than that of other languages because character, integer, and float data may be combined rather freely. For instance, you can substitute a `float` for a `char` late in the program without causing havoc, even though a float is a single, precise number that requires four times the memory space of a `char`.

Unlike other languages, C has no significant extensions. The standard set created by Ritchie has so many built-in features, and the tools to create so many more, that no extensions have been needed. Keeping the language simple and unencumbered by add-ons helps to ensure that C can be used on many different machines.

This portability is one factor that has made C a great favorite with programmers. There are two contradictory currents in computer development today, compatibility and individuality. From the user's point of view, it is annoying when a difference in machine architecture prevents a program from running on a particular computer. On the other hand, computer manufacturers are deliberately choosing a marketing policy of distinctiveness and noncompatibility in order to tie customers to a particular brand of machine and its software.

So far, C has been able to transcend this dilemma. It produces a source code that produces runnable object code when transported to a new programming environment and recompiled. Developers can move C programs with a minimum of tinkering and fuss.

Once a compiler is developed for a particular machine, C source code can be processed by that compiler in complex ways to mesh with the internal workings of the target machine

Hello, World!

An excerpt from the book Learning to Program in C by Tom Plum, analyzing the standard first program for C language beginners.

The first program to run in any environment is one which simply announces that it is working. In the C language community, the standard first program says

```
hello, world
```

and then quits. The following C program does nothing but print this message. (For any program in this book which you could enter and run on your computer, a duplicate listing will be found in Appendix B.)

```
hello.c
    main()
        {
        write(1, "hello,
        world\n",13);
        }
```

The program is found in a file named `hello.c` and contains four lines. A file like this, which contains a C program that you can print and read, is known as a source file and its readable contents are known as source code, or, colloquially, just code. The word `main` says that this is a main program, one that can be executed by itself. The opening brace marks the beginning of the program, and the closing brace marks its end. The line

```
write(1, "hello, world\n",
13);
```

writes the 13 characters between the quotes to your terminal (specified by the 1). The code \n stands for newline, which causes the display to end the current line and start a new one, much like the Return key on a typewriter. It consists of two characters in the source file, but in the eventual program it counts as one character.

If you have access to a computer, we suggest that you try out each of the steps in the following recipe.

- To get our C program into the computer, we need to use a text editor, a program that creates or modifies files of text such as programs. The result of editing is a source file named `hello.c`.
- If we have made any mistakes in entering the program, or wish to make changes to an existing program, we again use the text editor to make the changes.
- We use the compiler to produce an executable program. In our common environment, the compiler is invoked with the command

```
cc hello.c
```

The compiler then goes to work. During its work, it produces a file of assembler code, a human-readable version of the machine instructions needed for the program. If you do not tell the compiler to stop with the assembler code, it goes on to produce a file known as an object-code file, or object file. The object file is simply a series of numbers, the actual hardware instructions to execute your program. The compiler then turns the job over to the linker, which combines the instructions for the `hello.c` program with instructions from a link library. The instructions for `write`, for example, are found in this library. The end result is an executable program, named `a.out` in our common environment.

- We execute, or run, the executable program and should obtain the printout

```
hello, world
```

The whole sequence is summarized in

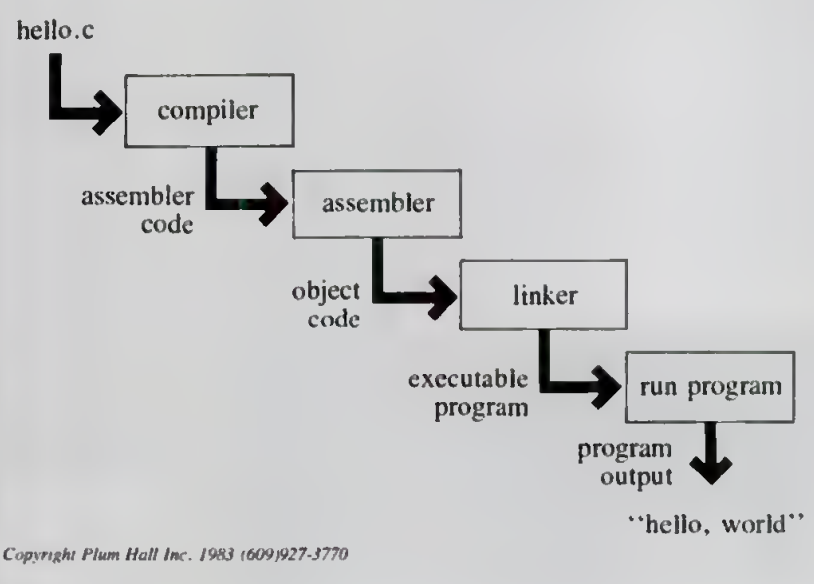
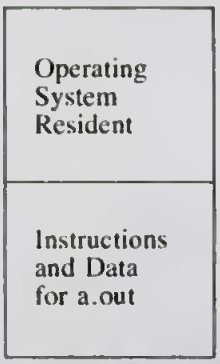


Figure 1: *This flow chart analyzes the simple C program, "hello, world".*

(Hello, World! continued)

Figure 1. This type of diagram is known as a data flow diagram: each box represents a program receiving input from the arrows flowing into it and producing output on the arrows flowing out of it.

The last step in the process—running the executable program—deserves further explanation. After the compilation process, the program (known as `a.out` in the Unix environment) exists as a file on a disk, containing machine instructions. When the user asks to run, or execute, the program, the process of "asking" is mediated by the operating system, which reads the user's commands from a terminal and then executes them. The operating system is itself a program which occupies space in the memory; that part of the operating system which continually "resides" in the memory is known as the resident. After the operating system locates the `a.out` file on the disk and reads it into the memory, the memory then looks something like the figure below.



Thus, the loading process has read the instructions and data for `a.out` into the machine memory. In the diagram, the memory also contains an operating system. Between the two of them, they contain all that is necessary for `a.out` to do its work.

Such is the picture when the program compiles successfully. Quite often, while learning the language you will have errors in your program which the compiler will complain about.

One common type of error is a syntax error—the format of your program is not what the compiler expects. Unfortunately for the learner, many C compilers are not great at giving you a human-oriented description of the underlying problem. For example, edit your `hello.c` file and remove the semicolon, to produce

```
helbad.c:
    main()
        {
        write(1, "hello,
        world\n", 13)
        }
```

On compiling the result, you may encounter messages such as this:

```
helbad.c:4: Statement
syntax
```

Each such message tells you what file was being compiled, what line number the compiler was reading, and a description of the problem. In this case, the compiler complains about the syntax of line 4, but line 4 actually is all right—the problem is that the program is missing the semicolon on line 3. Often, the real problem will be one line sooner or one line later than the compiler tells you.

Continue this exercise by removing other components of the program and observe the results. If you are lucky, you can get the compiler to give you quite a long list of error messages. Fix the first error and see how many messages go away as a result. **—Tom Plum**

Cheaper compilers may lack certain features; their libraries may contain fewer prewritten functions or they may lack the ability to declare `floats`, precise numbers requiring significant memory. But if the source code were rerun through a superior compiler, the missing elements would be added. And once a compiler has been developed for a particular machine, C source code written on that machine can be recompiled and run on most 8-bit and 16-bit machines.

Compilers range in price from $50 to more than $500. Perfectly adequate compilers are being developed in the lower range, so a hobbyist who wants a taste of C can take a tentative nibble before making a major financial commitment. If he later chooses to upgrade, code written for the low-end compiler will run on a more extensive and expensive one.

Diving into C

So you've caught the bug. You've spent your money on the compiler of your choice and you're sitting in front of your PC with your screen editor on the A prompt. You're now ready to write your first C program.

```
main()
{
char*name;
 printf("What is your
 name?");
 scanf("%s",name);
 printf("Hi,%s\n",name);
}
```

This is truly a user-friendly program—it makes your machine talk to you. With your editor, enter the program above. Make sure you pay strict attention to detail. For instance, if there is a space between main and ( ), your program won't compile. If you leave out the semicolon after `printf ("What is your name?")`; your program won't compile.

You have to follow C syntax religiously. Errors and omissions are unavoidable when you're getting started, so be prepared to return to alter your source code

Errors are unavoidable when you start, so be prepared to alter your source code.

and make it appear exactly as shown above.

Depending upon what text editor you're using, you'll be asked at some point to give your source code a name. Call it `name.c`,

Now that you've entered the program, proceed to Phase 1 of the compiler. With the program diskette in drive A, key in

```
B:LC1 name.c
```

and hit the Return key. Let's assume that your source code has happily passed through Phase 1 of the compiler without any errors. You are now ready to invoke Phase 2. Type in

```
B:LC2 name.c
```

and hit the Return key.

Once this second compilation is finished, you're nearly there. There's just one last step: your program has to be linked to the compiler's library. Out of these smaller modules, stored in C's library, mighty programs are built.

You execute the linking function by inserting the DOS linker and typing

```
b:link name.c
```

You will then be asked a series of questions. First, you'll be asked to name your file. Call it `b:name.c`. Do you want a map of the functions? Hit the spacebar for no, the default option. You'll only want the mapping function when you begin doing very advanced work. The third and last question asks you to invoke the library search command. Type in LC and hit the Ctrl key.

Congratulations. Your program is now ready to run. Key in

```
a:name.c
```

and you'll find your source code has been transformed into object code that, at the command, will ask, "What Is Your Name?" and display your response after you enter it.

Once you master the routine, you will be able to compile any C program that is written correctly. The mechanics of invoking the compiler and linker become easy with practice.

The actual compilation phase takes only seconds and you have your reward. The end product: a portable source code and an executable C program. ■

Nat Sakowski and Leslie Baker run a consulting firm specializing in software marketing, product evaluation, and documentation.

```
main()
{

    printf("This is my first C program.\n");

}
```

main()	is the function that marks the beginning of a C program. *All* C programs start this way. It can be used only once in a program since it shows the computer where the program starts.
{	The opening brace, or curly brace, indicates the opening of the function body which can contain one or more statements. Multiple statements are separated by semicolons.
printf()	One of the functions contained in the library of the C compiler, this is the command to display on the screen the message between the quotation marks. The information contained within the parenthesis—"This is my first C program"—is called the argument of the function. In this case it is a string of characters to be displayed on the screen.
/n	The newline character does exactly that—it sends the cursor to the next line after the message prints.
;	marks the end of a C program statement.
}	The closing brace indicates the end of the function body and the program.

Figure 1: *This is how a very simple C program looks. If you are new to C, the accompanying annotation will help you understand its symbols and syntax.*

COVER STORY/MARK S. ZACHMANN

The MWC-86C Compiler

The Mark Williams Company offers a C compiler with two new data types, structure passing, and longer identifiers.

The Mark Williams Company is best known for its Coherent operating system, the Unix act-alike designed specifically for the IBM PC. But, acknowledging that PC-DOS and MS-DOS are now standard for the PC, this company is offering the MWC-86 C Compiler (hereafter referred to as MWC), which can run on PC- or MS-DOS 2.0.

C compilers are always compared with the standard set forth in *The C Programming Language*, a book by Brian Kernighan and Dennis Ritchie (henceforth referred to as K+R). MWC follows this standard and also contains some major enhancements. These include some new data types, structure passing, nested comments, and longer identifiers.

One thing that advocates of structured programming will find helpful in MWC is its two new data types. First, a function may be declared as a `void` data type, in

Photograph: Geoff Spear

which case it does not return a result. You can use this to ensure that you do not accidentally try to use a value returned by this function; if you do, the compiler will give you an error message. Second, MWC contains an `enum` data type which, much like a Pascal subrange data type, enumerates a finite number of values. For example, you may declare that:

```
enum opinion{yes, no, maybe}x;
```

which implies that x may take on values of yes, no, or maybe. The values, yes, no, and maybe become constants, with the usual conflict warnings that you may no longer define your new constants as variables.

MWC also includes some additional unsigned data types, such as unsigned long integer and unsigned character. In the K+R standard, these data types are always signed.

One feature anticipated for standard C, and included in MWC, is the ability to assign structures—that is, to transfer the contents from one structure to another. It is also possible to pass structures to functions and to return structures from funtions. Nested comments are useful for creating headings and placing comments in parentheses.

Finally, identifiers in MWC may have up to 127 significant characters, while standard C supports only 8. This is a useful feature for programmers using this compiler, although it may cause portability problems.

One of the nicer things about MWC is a switch, `vsbook`, which can be included in the compiler call. It causes the compiler to generate warning messages when code is non-K+R standard, even if the code is suitable in this environment. This feature can be of significant assistance when the code is recompiled.

MWC-86 C Compiler, Version 1.0
Mark Williams Company
1430 W. Wrightwood Ave.
Chicago, IL 60614
(312) 472-6659
List Price: $500
Requires: PC-DOS 2.0, 128K RAM.

CIRCLE 717 ON READER SERVICE CARD

DOS Support

Support for binary files, which is not part of the K+R standard, seems very easy to use and is quite effective. By using a `b` directive (as in `fopen( myfile, rb)`) you can inform the compiler that a file is binary, rather than ASCII.

Nested comments are useful for creating headings and placing comments in parentheses.

Although a means is provided for redirected binary I/O (the substitution of a file or another device for the console), it does not actually work under DOS 2.0, the DOS 2.0's own redirection takes precedence.

Function calls are provided for interfacing directly with the operating system. These are fairly complete, but there is no support at all for PC BIOS calls (other than for interrupt 21). Furthermore, the DOS calls are a bit clumsy. There is no support for manipulating file directories or accessing files through a DOS 2.0 directory tree.

Hardware

The MWC compiler comes on one double-sided nine-sector diskette. If you put all files on a 360K floppy disk, this leaves about 20K left over for program development. With a PC with two drives, you could keep the compiler on one floppy disk and a text-editor and data files on the other. By removing some of the unnecessary utilities, you can squeeze a small development system onto a 360K floppy disk.

MWC supports two memory models: small and compact. The small model limits a program to 64K of data and 64K of code. The compact model fits the entire program in 64K.

MWC is a four-pass compiler. The first pass (the preprocessor) handles macro and `#define` substitutions. The next two passes translate the code into an object module. This object module is not PC-DOS compatible until it passes through MWC's own linker/loader, which links object modules and libraries to produce executable code.

Also included with the compiler are three utility programs. There is an object librarian (`lb`), routine (`strip`) which strips off the symbol table to shrink the executable code, and a symbol table list routine (`nm`). These utilities all work on MWC-compatible files, object modules which have not yet been processed by MWC's linker/loader; they do not work on linked, PC-DOS compatible files. In fact, I could not convince `strip` to do anything at all, except delete files.

The compiler has an option of producing assembly code files or direct object code. The assembly code used is a pidgin form of Intel's assembler, rather than IBM's Macro Assembler syntax. I found this AS assembly code significantly more difficult to read and harder to learn than the IBM assembler. Still, it is usable for

making short assembly language routines or optimizing compiler output.

Each of the portions of the compiler has numerous options for customizing error messages and runtime parameters. In general, you can ignore the options and utilize the cc program to compile. For example:

```
cc hello.c
```

is all that is needed to compile and link source code named `hello.c`, producing a `hello.exe` executable program. Most options may be included on the cc command line, so I doubt that most users will bother learning the more complete syntax for the various passes.

Since each pass is a separate program, you can run the passes separately. This is most useful with respect to the preprocessor used in the first pass. For learning experience and debugging, it is worthwhile to see exactly how the preprocessor translates source code. For example, the two lines

```
#define count 12
      i += count;
```

become

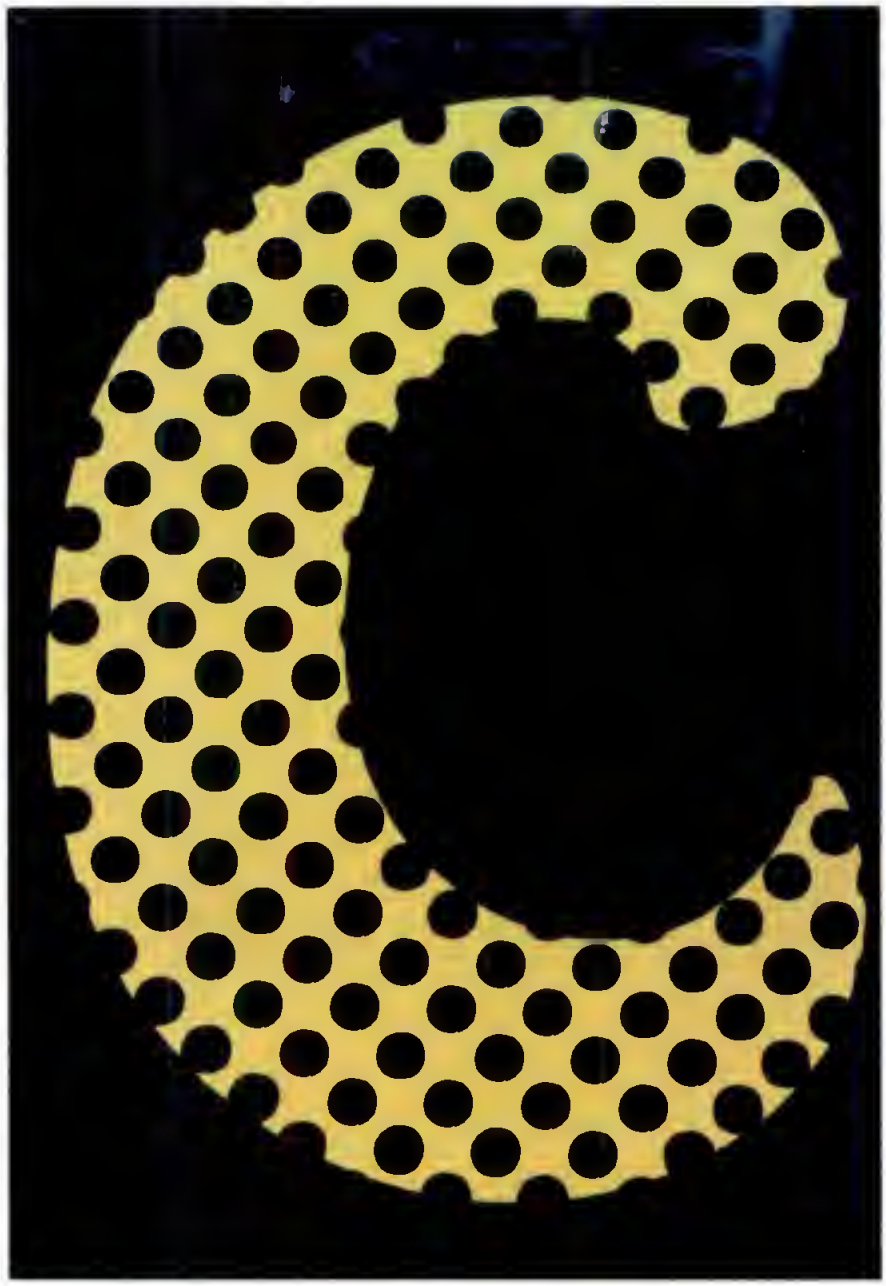
```
i += 12;
```

after running through the preprocessor. Since macros are expanded as well, this is a handy way to catch coding errors that prevented a macro from being expanded as you had planned. The preprocessor is invoked as

```
cpp hello.c
```

for the source code named `hello.c`.

Strangely enough, no C source code files are included with MWC. One would expect some sample files to guide the user through learning the language. With such sketchy documentation, it may be quite a while before your first program runs.



Performance

The overall performance of MWC was exemplary. It was particularly fast at compiling and linking. Execution times were typical for a high-quality C compiler on the PC.

Figure 1 compares MWC to the Lattice C compiler for compile, link, and runtimes on programs of varying size. Disk I/O and floating-point performance were not evaluated.

Note that MWC has no support for the 8087 chip, which is dedicated to floating-point instructions. My few attempts at using floating point seemed satisfactory; tangent (PI/2) gave infinity, and tangent (PI/4) gave 1.

In MWC all file I/O is buffered, which may reduce execution speed. This may be ameliorated by defining the buffer address for the file, in which case the buffer may be directly manipulated. This is a neater

Program: hello.c

	RAM disk	Diskette	
Compile	0:08	0:43	MWC
Link	0:15	0:34	
Compile	0:04	0:20	Lattice C
Link	0:13	0:28	

Program: Large program fragment (500+ lines)

	RAM disk	Diskette	
Compile	0:33	1:05	MWC
Compile	1:50	3:10	Lattice C

Runtimes

sieve.c	funct.c	pointer.c	
1:04	1:02	0:39	MWC
1:44	1:10	0:38	Lattice C

Figure 1. *Compile, link, and run-time comparisons between the MWC and Lattice C compilers. For a description and progrom listing of hello.c, see sidebar "Hello, World!" accompanying "Getting Your C-Legs" in this issue. The sieve.c program listing can be found in "Five C Language Compilers" (PC, Volume 1 Number 10). Program listings for funct.c and pointer.c are shown in "The Whitesmiths Notive C Compiler" article in this issue.*

and cleaner approach than most unbuffered file handling routines available on other C compilers.

Timings

Figure 1 shows compile and link times for a small and a large C program, as well as run-times for three benchmark programs. Times were very good. For comparison purposes, I have included the times for the Lattice C compiler.

The MWC has some speed advantages for these simple programs because it uses the SI and DI registers for `register` variables, while Lattice C does not support `register` variables.

Optimization

As far as I can tell, MWC has no code optimization at all. If you do not declare a variable as `register` it never is. Similarly, routines always push, then pop the register variables, SI and DI, on to and off of the stack even if the routine itself has not used these registers. There is no loop, case, or even assignment optimization. For example, the program fragment:

```
int a,b,c;
a=1;
b=a;
c=a;
```

becomes:

```
mov [BP+B],1
mov AX, [BP+8]
mov [BP+10],AX
mov AX, [BP+8]
mov [BP+10],AX
```

(I have illustrated this in 8088 assembler code, rather than in MWC's form of Intel's assembler.)

Error Handling

This C compiler is an enigma. When it finds an error, it produces some of the best error messages I have seen. When it does not detect an error, the system crashes.

For example, the error-checking rou-

tine found my declaration of a local variable that was not used in a function. The `funct.c` program has a subroutine:

```
value(v)
int v;
{
        int evenspace [1000];
        return(v);
}
```

The compiler actually noted that the `evenspace` variable is not used in the `value` subroutine, but it did not optimize it out of the subroutine. Nor did it produce code that showed knowledge of the `evenspace` variable.

When the diskette was delivered, the header files (`stdio.h`, `ctype.h`, and so forth) were invalid, each missing the carriage return/line feed pair at the end of the file. The compiler did not detect this, and the preprocessor went off into never-never land upon encountering the anomaly.

Similarly, when I tried to compile a program that began with `#Include`—rather than `#include`—I received no error messages, and the compile seemed to proceed. I should have received an error message, because C language statements must be written in lowercase. However, no new .EXE program file was created; rather, the older, version of the .EXE file was left on the disk. This could lead to much frustrating debugging.

Other errors, such as lack of disk space and missing files, were noted and handled appropriately. The error-trapping of the library functions seemed good, although `strip`, in particular, was nonfunctioning.

All told, error-checking on the MWC compiler seems excellent, though a few errors were not found. As new versions appear, these bugs should be corrected.

Documentation

The documentation was labeled "preliminary," and this is certainly an apt description. At the time I reviewed it the PC-DOS product had been available for more than 3 months, and I expected better documentation. It did not contain an index or a tutorial introduction to how to use the compiler. Both are sorely needed.

The library routines were listed, in a somewhat sketchy manner, at the back of the manual. Three appendixes referred to in the seventh chapter were missing. They were meant to include instructions on how to substitute your own routines for library routines, a listing of error messages, and a description of the run-time structure. Since the error messages on MWC are quite good, the lack of error messages in the manual was not disastrous.

The manual is divided into eight chapters, and the pages are numbered independently for each chapter. But the chapter numbers can be found only on the title pages. The table of contents is good, but looking for specific pages requires a lot of thumbing through the manual.

The introductory material, including the description of the compiler switches or options, is disorganized and difficult to read. There is no coherent table that lists compiler switches, and the switch definitions are hardly obvious.

The library routines are almost in alphabetical order, but the primary ordering is by library (MWC has three object libraries), which makes the alphabetical ordering less useful. The discussions of library routines are adequate for experienced programmers, but novices will probably have trouble.

All in all, this "preliminary" documentation was barely adequate, and it makes learning and using the compiler a chore even for experienced programmers. I hope the documentation is revamped the next time around.

Summary

The Mark Williams C compiler is a very good product, but its rough edges make it difficult to recommend for general use. The documentation needs an overhaul, as do some of the more annoying bugs.

The worst features of MWC are caused by its origins in Coherent, the company's operating system. These are the nonstandard assembler interface (which can be ignored) and the custom linker, which limits the usefulness of the librarian.

Rough edges aside, MWC is a very promising product. I like the ability to see or file the preprocessor output, as well as the binary file support. The I/O redirection is at the mercy of DOS 2.0, unfortunately, which is a problem shared by all of the current C compilers.

Performance was excellent, and the `cc` program shell makes compilation simple for small tasks. Its adherence to the K+R standard is exemplary, and the enhancements are well thought out and useful. Plus, portability is significantly enhanced by the `vsbook` option.

Overall, with a bit more seasoning, this will be a good professional product. Some of the features are so useful that they left me wondering why other compilers don't include them. ■

"Preliminary" is an apt description of the documentation.

COVER STORY/MARK S. ZACHMANN

The Whitesmiths C Native Compiler

The Whitesmiths C Native Compiler for the IBM PC is a professional package for experienced language programmers. How does it stack up against other C compilers? In some ways, very well, but some of its idiosyncrasies can be frustrating.

Photograph: Geoff Spear

WHITESMITHS C COMPILER

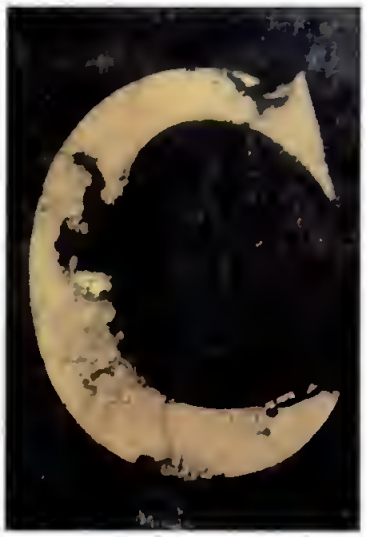
The language C has been receiving widespread attention lately. This fast, efficient, and portable language has been the subject of a number of articles, and, for several reasons, its popularity can be expected to grow.

First, C is a structured language, which helps professional programmers to write easily commented and debugged code. This is important when you consider that the major cost of software development is programmer time. Second, by its very nature, C tends to produce extremely fast-running and space-efficient programs, which are a necessity for microcomputers and operating systems. (Anyone who has tried to run a long BASIC program will attest to this fact.) Finally, C is, without a doubt, the most portable language available for microcomputers. Its portability is a result of the excellent original design work by its creators at Bell Labs. The C language contains virtually all of the constructs necessary for writing complex programs, without the need for all of the nonstandardized extensions found in commercial Pascal compilers and BASIC interpreters.

One of the first C compilers available for microcomputers, the C Native Compiler, came from a company called Whitesmiths, Ltd. It surprised the programming community by producing a complete C compiler for the rather limited 8080 and Z-80 processors. Furthermore, this C compiler allowed programmers to work on a Digital Equipment Company (DEC) mainframe computer and then "cross-compile" the results into programs suitable for the microcomputers. A cross-compiler is a compiler that runs on one machine (DEC in this case) but produces code for another machine (known as the "target"). The advantage to a cross-compiler scheme is that programmers can work together on a large mainframe, sharing information, while debugging and compiling many times faster than they could on a microcomputer.

C Native Compiler, Release 2.2
Whitesmiths, Ltd.
97 Lowell Rd.
Concord, MA 01742
(617) 369-8499
List Price: $550
Requires: 128K RAM, two disk drives.

CIRCLE 715 ON READER SERVICE CARD



The differences between the C standard and WhC are relatively minor.

When the Z-80 compiler was introduced, it suffered from two major problems. First, the compiler was very slow in operation. It was clearly designed for the hard disk environment of the DEC machines, which made it virtually unusable in the Z-80 environment. Second, the C language comes complete with routines specified by its authors, Brian Kernighan and Dennis Ritchie (hereafter referred to as K+R) in their book *The C Programming Language*. Although these routines—string catenation and print formatting, for example—are not strictly part of the language specification, programmers expect to find them in any C compiler's support library. Whitesmiths decided to "improve" the language by providing more powerful, but, unfortunately, incompatible routines. This is roughly analogous to altering BASIC's PRINT command; it might be nice, but it won't do what you might expect it to.

Now Whitesmiths has released the IBM PC version (release 2.2) of the C Native Compiler. How does it stack up with the existing compilers? In some ways, very well indeed. In others—well—read on.

Language Specifications

The Whitesmiths C compiler (abbreviated WhC to avoid the mildly scatological WC) inherits a number of features from its predecessor. WhC is compatible with implementations for other machines, including the DEC PDP series, the DEC VAX, the 68000, and the Z-80. Programming shops can develop software on one of the larger machines and then transport it to the PC.

WhC differs from the earlier Whitesmiths version in that the company has finally bowed to the inevitable and is now providing all of the K+R utilities, such as `printf`. These utilities are still not part of stock WhC, but require linkage of another library and a set of macros, with routines that alter the arguments and then call the usual, nonstandard Whitesmiths routines. There is some small loss in memory and time efficiency.

This approach can be a problem in debugging; expected routines may not show up in the cross reference, since the macros have invisibly turned them into their WhC counterparts.

The differences between the C standard and WhC are relatively minor, and they are well documented. There are two important differences: First, with WhC each external declaration must be declared as static and initialized exactly once, and, second, structures and unions have their own name spaces.

The C standard allows externals to be

uninitialized. The standard also gives structures and unions a common name space. For example, the code fragment shown in Figure 1 is perfectly okay in standard C.

As you would expect, using a common name is discouraged for readable code. In fact, WhC even allows a compile time option to have separate name spaces for every structure and union, so that programmers need not worry about name conflicts between structure member names.

The compiler also enforces a limit of three register variables. Although this is a hardware limitation of the 8088, it does imply that somewhat more time must be spent converting code.

Extensions to WhC include unsigned chars (character variables) and `longs` (32-bit integers), union initialization, and character constants with more than one character.

The Whitesmiths Runtime Library

An expected part of any professional compiler is the runtime library, a set of routines expected to handle the low-level operations, such as memory management and file operations. WhC is full of these routines, providing it with versatility.

Perhaps the most important of these extensions is the ability to asynchronously trap important events. This includes errors as well as things like the Ctrl-Break key. For example, you may have a long report to print out, but wish to stop printing by hitting Ctrl-Break. Or, in case of a disk error, you may wish to just print an error message and then return to the beginning of the program. This may be done with WhC, although not all that easily. In fact, one of the oddest pieces of documentation covers the `when` routine, which fields interrupts. The comment (listed under bugs) reads: "You are not expected to understand this."

Another set of extremely useful routines is provided for file operations and command line processing. These do simple but useful things, such as picking off command line options that start with the flag character (−) and getting file names from the command line. (The command line is everything to the right of the file name when you run the program.)

In an amazingly quick response to IBM and MicroSoft, WhC also contains substantial support for the newer DOS 2.0 conventions, including DOS 2.0-specific calls for handling trees and redirecting I/O.

```
struct    segments {
      int es,ds;
      } mysegment;

union     something {
      int a;
      char b;
      long c;
      } mysomething;

int y;

y = mysomething.es;
```

Figure 1: *The C standard allows externals to be uninitialized and gives structures and unions a common name space.*

What about WhC and the K+R standard? Again, Whitesmiths has refused to actually provide the K+R routines. Perhaps this was done to maintain compatibility with earlier versions. In any case, I consider it a serious defect. For example, rather than provide the routine `strcmp`, which compares two strings, WhC contains an identical routine called `cmpstr`—I can't find any sane reason for such a maneuver.

Unlike other C compilers previously reviewed (see, "Five C Language Compilers," *PC*, Volume 1 Number 10). Whitesmiths charges for its run-time package. Software authors who use the results of WhC in a program must pay a licensing fee in order to sell the end product. Although you can provide your own run-time support (and the documentation seems to be complete enough to allow that), it is a nontrivial task. The licensing fees are quite reasonable for a software development company: The cost per unit is $25; up to 100 units, $500; up to 1,000 units, $2,000; unlimited units, $4,000.

In order to safeguard its non-copy-protected compiler, Whitesmiths has come up with a number of approaches. First, when you install the compiler, it prints out an extremely long warning about copyright protection. Next, the program informs you that you must affix to your computer the sticker that the company provides in order to use the compiler on your machine. This sticker tells one and all that you are a true owner of Whitesmiths' C. Thank goodness others haven't followed this trend, or my computer would look like a travelogue.

In fact, the copy I received for review came with the strictest agreement regarding evaluation I have ever seen.

Portability

Portability involves two issues: portability to other C compilers, and moving code among Whitesmiths compilers running on different computers.

As I said, I was less than ecstatic about the differences between K+R and WhC run-time support in earlier versions. But with the addition of the LIBU.86 library, users can run K+R examples and port code from other compilers with minimal effort.

Portability to other Whitesmiths compilers is excellent. Clearly, portability was a primary consideration, although I believe much of this effort was misdirected. Whitesmiths attempts to convince users to use their data typing, instead of standard C typing, to increase a program's portability. For example, the type definition `count` is a number between −32768 and 32767 (better known as 2 bytes).

Although you can use the `typedef count` and obtain the exact range of the result, I am ambivalent about this artifice. It does increase portability, but only when you write code that works only for certain word lengths. For the most part, it is better

to write code for a general integer (which may be 16 bits on the 8088, 32 bits on an IBM 370, and 36 bits on a Honeywell 6000). Further, on the Honeywell machine, if WhC really enforces the strong typing, there is a loss in efficiency, because the top 18 bits get continually masked out.

The very first example in *The C Programming Language* is a trivial program that simply prints the string `hello, world!` (see Figure 2). The WhC standard version of this program is shown in Figure 3. This version enforces more rigorous rules. It makes sure that a program returns a value (`yes`), which is a 1 or 0 (`bool`), and since WhC does not have a `printf` function, the `write` function is used. The result is code that is more structured, more portable, and less readable. Of course, you can write the program the first way by linking LIBU.86 and using both `std.h` and `stdio.h`, but every bit of the WhC documentation assumes you are masochistic enough to want to use its type definitions and I/O conventions.

For example, the routine to write a single byte (`putc`) is documented as:

```
count putc(pfio, c)
fio *pfio;
count c;
```

Nonetheless, the documentation is better and more portable than the usual int, FILE, and char, but it is harder to understand for both novices and experienced C programmers who are used to other compilers.

```
#include "stdio.h"

main()
{
        printf("Hello, world!\n");
}
```

Figure 2: *The first example in Kernighan and Ritchie's book prints the simple program, Hello, world!*

```
#include "std.h"

BOOL main()
{
        write(STDOUT, "Hello, world!\n",12);
        return(YES);
}
```

Figure 3: *The WhC standard version of the progrom, Hello, world!*

Hello World:

Compile	Link	
11	22	WhC (ramdisk)
4.5	10	Lattice "
45	60	WhC (diskette)
17	34	Lattice "

Figure 4: *A comparison of compile and link times for WhC ond Lattice C using the program, Hello, world!*

Compile times : long program

Diskette	Ramdisk	
6:36	5:13	WhC
4:05	2:18	Lattice

Figure 5: *A comparison of compile times for WhC ond Lattice C using a long program.*

Hardware

The Whitesmiths C comes on three diskettes. A minimum configuration requires 100K RAM for the compilation and another 75K for the linkage programs. Compilation is a four-stage process, which consists of the preprocessor, two levels of processing, followed by the assembler. You have a choice of assembly code in either Whitesmiths' or Intel's (nearly IBM assembler) format. Having the output in IBM assembler format is virtually useless except visually, since the linker expects object code in Whitesmiths' format, which differs from the output of the IBM assembler.

The compiler also comes with two utilities for managing object code files. There is a function for adding, displaying, and deleting modules from libraries. There is another function for displaying a tree-type of structure of a library.

The most useful Whitesmiths routine, the profiler, is not supplied with the 8088 program package. The profiler tells you approximately where your program is spending the majority of its time. It is available only with Whitesmiths' proprietary IDRIS operating system (which is very similar to the Unix system).

Whitesmiths does provide a number of features that are extremely useful from the hardware end. It supports two memory-model sizes (small and medium), although it does so in a nonstandard manner. You may select everything restricted to 64K or separate code and data segments. Further, you can specify that some routines are far routines.

The compiler comes with support for the 8087 chip, as well as an option to increase efficiency by using the added instructions of the newer 80186 and 80286 chips.

Performance

For most programmers, performance is the most important consideration. Does WhC produce faster, more compact code? To find out, I compared timings with the previous speed champ, Lattice C. Since WhC produces assembly code, for comparison purposes I also took a look at some of the intermediate assembler output (which is an alternative to using DEBUG in disassembling Lattice code).

All tests were performed on two media types, double-sided floppies under DOS 2.0 with 15 buffers, and RAM disk.

First, I compared compile and link times for the simple, "Hello, world!" example (see Figure 4). Compilation includes assembly for WhC. I made five attempts before I managed to compile this simple program under WhC. (The numbers indicate the program times, not the amount of time it took me to figure out how to run Whitesmiths.) Also, the WhC required using an additional file, `std.h`, so I included that in the Lattice version as well. Next, I compiled a very long program—about 600 lines plus another 150 in an include file (see Figure 5).

In Figure 5 the linkage times were not calculated because it is a program fragment, and, since WhC has no provision for assembly linkage, I could not link all of the associated modules.

As for runtime comparisons, I used three programs: the `sieve.c` program used by Hanno Hinsch in a C comparison

(see "Five C Language Compilers," *PC*, Volume 1 Number 10), as well as two other programs. One, `pointer.c` (see Figure 6), measures pointer arithmetic (taken from *Byte* magazine's article, "Nine C Compilers for the IBM PC," in its August 1983 issue). The other, FUNCT.C, measures function calling and localization overhead (see Figure 7).

In this case, the `sieve.c` program will not work as given in the *PC* article, since the global "flags" is uninitialized. I initialized it to zero, which has no effect on run-time (see Figure 8). The two values for Sieve are derived from declarations as register/nonregister variables for the counters.

Note that Whitesmiths did very well in the Sieve runtime comparison because it maintains three register variables, two of which were used. Times for the more complex programs were comparable.

The comparable times for the `funct.c` program imply that Whitesmiths has noticeably more function calling overhead, since the `for( )` loops were demonstrably faster. This illustrates the trade-offs in register variables. When they are loop variables, using them increases loop speed, but it decreases function calling efficiency for simple functions, since the registers need to be stacked.

Whitesmiths does have the neat feature of allowing you to select the number of register variables. However, this seemed to have no effect on execution time, at least within the inaccuracy of my test.

To dig deeper into the internals, the WhC compiler provides almost no run-time optimization, other than the simplest Constant optimization (see Figure 9).

Both compilers use the AX register for returned values. The Lattice compiler is smart enough to recognize that AX contains the value of the variable `c`, so there is no need to reload it, while the Whitesmiths compiler automatically loads `c` into AX to return the right value. Of course, since you have the assembly code to play with, you can edit before finishing the

```
/*      POINTER.C  pointer manipulation routines        */

#define COUNTER         10000
#define ALLOTTED        128

main()
{
    char workarea[ALLOTTED], *ptr;
    register int i;

        printf("Starting\n");
        for(i=0; i < COUNTER; ++i)      {
                ptr = workarea;
                while( ptr < (workarea + ALLOTTED))     {
                        *ptr = ' ';
                        ++ptr;
                        }
                }
        printf("Finished\n");

}

/*      POINTER.C  end          */
```

Figure 6: *The pointer.c program used for run-time comparisons.*

```
/*      FUNCT.C         Check function overhead

#define COUNTER         10000
#define COUNT2          50
#define EXTRA           1200


main()
{

        int i,j, k;

        printf("Starting\n");

        j = 0;

        for(k=0; k < COUNT2; k++)
                for(i=0; i < COUNTER; i++)
                        i += value(j);

        printf("Finished\n");
}

int value(rval)
int rval;
{
        char extraspace[EXTRA];

        return(rval);
}

/*  FUNCT.C    end  */
```

Figure 7: *The funct.c program used for run-time comparisons.*

Runtime Comparisons

Sieve	Pointers	Functions
1:08/2:12	44	52
1:44	38	1:10

Figure 8: *A run-time comparison of WhC and Lattice C using the slightly altered sieve.c program.*

compilation. Most users would just as soon have the compiler perform the optimization.

Nevertheless, in summary, the performance of the WhC compiler is very good. For some routines it will produce faster code than Lattice will, while for others, it is slower. The two compilers perform in different ways, which may indicate that both are producing essentially the fastest C code possible for the 8088, within a small margin of error.

Documentation

The documentation that comes with the compiler is very much like the IBM documentation. It assumes that you know what you are looking for. There is no index—a serious omission—and most information is provided in the form of alphabetized listings of functions.

The package itself consists of two somewhat unwieldy IBM-sized spiral binders with clear, legible printing. Each binder begins with a very complete discussion of programming practice and hardware constraints. The *C Programmers Reference Guide* is applicable to all of the Whitesmiths compilers, while the *C Interface Manual for the 8086* contains information specific to this implementation.

If you are a serious programmer who has programmed extensively in C, you will appreciate the documentation's detail. However, some aspects, such as the interrupt trapping, are not well documented. There is no discussion, or even an example, of how to invoke it or how to take advantage of it.

The same holds true for actually using the compiler. Whitesmiths' documentation does not discuss how to link 8088 assembler output (it's not possible). Similarly, handling of disk file errors is not well documented, either.

```
            Optimization Check:

C code:
            crc += c;
            return(c);

becomes:
(Whitesmiths)

            mov         AX,[BP-8]
            add         [CRC],AX
            mov         AX,[BP-8]
            (return)
(Lattice)

            mov         AX,[BP+2]
            add         [CRC],AX
            (return)
```

Figure 9: *An optimization check of the WhC compiler.*

Otherwise, the documentation is exemplary in completeness. Each runtime function includes a discussion of the function, along with bugs and hardware/system dependencies. Each function includes an example that is generally usable.

If you are not an experienced programmer, this package is not for you. Even if you are, expect to devote a fair amount of time to reading the manuals until you are familiar with the WhC idiosyncracies.

Error Handling

The error trapping in the C compiler seems to be very good, but finding out how to use it is another matter. I could not understand it, even after hours of study.

The compiler itself seems to produce bug-free code, as you might expect from a mature product. It would be nice, however, if the compiler were as bug-free in operation as it is in generation. Hardware errors seem to be poorly trapped. For example, I ran out of disk space and the compiler gave absolutely no sign; it just produced an empty object code file, which was no fun to debug.

Similarly, compiler error messages are pithy and not informative. For example, the first pass syntax looks like this:

```
pl -n8 -o source.tm2
source.tml
```

When I tried to set this to 0 register variables (using a -r0 flag), I inadvertently put the -r0 beyond the -o. Unfortunately, -o expects a source file name immediately following it. It gave the error message:

```
panic no func    line 0!
```

Not exactly what I consider useful. Similarly, other error messages (for example, neglecting to initialize the "flags" variable in the SIEVE.C program) were also correct but not helpful.

Conclusion

Whitesmiths' C compiler is an extremely professional package designed for people with a lot of programming experience, particularly in C. It produces good code and it is compatible with compilers and cross-compilers running under large mainframes. Some of the additional features provided by the Whitesmiths C compiler are quite good; it would make sense for other designers to implement them.

However, as a professional, I find the rather slow compile and link, the inability to combine code with the IBM assembler, and the nonstandard runtime library and `typedefs` to be significant liabilities. But the versatility of the processor and preprocessor, along with the ability to develop programs on a faster machine, make WhC a viable compiler. ■

COVER STORY/LESLIE BAKER & NAT SAKOWSKI

New Improved Lattice C

Version 2.0 of the Lattice C compiler offers more memory, adds functions to the C library, and speeds up procedures.

The Lattice C compiler, the elder statesman of C compilers for personal computers, just keeps on getting better. It has been around since 1980, which for a compiler is a long time indeed. Since its first apppearance, Lattice C has been enhanced several times. The newest version, 2.0, addresses more of the PC's memory than previous versions and makes greater use of the MS-DOS operating system. By all standards, the new Lattice C compiler is quite a piece of work.

Francis Lynch, the 32-year-old author of the compiler, is enthusiastic about the new developments. "We're very proud of the additions we have made to this version. C is growing in popularity, and many applications that demand more program and data space are being written in this language. The new Lattice C version gives software developers a choice of four different memory models."

Photograph: Geoff Spear

Lynch explained how the compiler works on C: "The compiler performs a series of operations on the C source code (the programs as written by the programmer), which turns them first into an intermediate code, called object code. A further processing and linking phase results in machine language code. The big advantage that C has is that the source code is highly portable."

Compiler Features

All C compilers are definitely not created equal. When we first used this language, we nearly went crazy trying to figure out what was wrong with some perfectly good C code that refused to compile. After considerable loss of equanimity, we discovered that the library of the compiler we were using did not include the data type, float. This refers to floating-point notation, the C mechanism for handling fractional numbers, which requires 4 bytes of memory. The obvious lesson that can be learned here: Take nothing for granted.

According to Lynch, a good compiler should let a programmer have full use of the Standard C programming language as created by B. Kernighan and D. Ritchie at Bell Labs. It should also include all standard I/O, string, character and memory allocation functions. Naturally, it has to compile and link at a reasonable speed. Lattice C has always done well with benchmark programs like the standard Sieve of Eratosthenes prime number calculation. But speed is not the main consideration; many other more subtle points about how a compiler interacts with source code are also important. "If a compiler gives programmers the kind of control that they want in their applications, then it does the job," commented Lynch.

Lattice 8086/8088 C Compiler
Lifeboat Associates
1651 Third Ave.
New York, NY 10028
(212) 860-0300
List Price: $500
Requires: 128K RAM, two disk drives.

CIRCLE 716 ON READER SERVICE CARD

Improvements

Our review of the new Lattice C compiler turned up good and bad news. The good news is that the new version makes greater use of the PC's capabilities. It addresses up to 1 megabyte of memory, the maximum the PC can support. The bad news is that programmers—even those familiar with version 1.4—will have to adjust to the compiler's new capabilities.

One improvement is the inclusion of the library function, `stdio`, which places characters into buffered memory, in the `consol.io` file. In many cases, skipping the intermediate buffering step results in faster compile times. Unfortunately, it can also result in longer programming time while you are learning the new version.

The new version hurdles the 64K RAM barrier and now offers up to 1 megabyte of program and data space. To support this amount of memory, the new version of Lattice C has four memory models, which give you the option of mixing and matching different amounts of program memory and data storage. The different models are based on different ways of addressing machine code. Once you choose your memory model, you have to stick with it because all functions have to be compiled using the same memory assumptions.

One option is model S, which has 64K of program space and 64K of data space. Model P gives you up to 1 megabyte of program memory and 64K of data memory. With model D, you are offered 64K RAM for programs and up to 1 megabyte for data. Model L gives you the best of both worlds: 1 megabyte of RAM in each category.

While the D and L models offer 4-byte pointers, the P and L models allow you to use `far` calls. One pitfall to avoid: Do not assume that a pointer will fit into the memory space allocated for an integer. In all memory models, 2 bytes of memory are held for integers, and only 64K bytes are held for data which are to remain in fixed memory locations.

Automatic data elements are similarly restricted to 64K. However, the D and L models allow unlimited allocation of dynamic memory and use of pointers in any memory location. You should choose the memory model to fit the job.

Using Memory Models

In all the models you must trade off efficiency—optimization of code and speed—with the ability to address the entire available memory. The 8086 processor inside the PC works best in memory Model S, where 64K bytes of program and data memory can be addressed. To choose the appropriate memory model, first ask yourself if the combined size of the functions in your program will be greater than 64K bytes. If not, the S and D models will optimize your code and run speed because they use `near` calls. These calls are faster and demand less coding. If your application requires more program address space than that offered by these two models you can select P or L. These models permit `far` calls, access functions in a larger segment of program memory, and will naturally be less efficient.

The second question to ask in choosing

a memory model concerns addressability throughout memory. Do you need more than 64K of data address space for your application? If you don't, your program will run more efficiently if you use the S or P models, because they use the more efficient 2-byte pointers. An alternative method for accessing specific memory locations is to use the `peek` and `poke` functions, which are new to the Lattice C library. But if you have to select pointers that use 4 bytes of memory, opt for the D and L models and pay the price.

In the 2.0 version, the procedure for calling the first phase of the compiler, LC1, has been changed to designate the new memory models. You do this on the LC1 command line by following the filename with a space, a minus sign (this is crucial), "M" for memory model, and the letter of the memory model you have selected. The full command for the filename `hello.c` and the smallest model—64K program memory and 64K data memory—would be: `LC1 hello.c -ms`. You can also designate the models using numbers 0 through 3: `-m0` would be the same as `-ms`.

In the link phase, you must specify the appropriate library (LCS.LIB, LCP.LIB, LCD.LIB, or LCL.LIB) because the compiler generates code segments with different names for each model.

The differences between the old and the new versions of Lattice C became apparent with our sample program in Figure 1, which demonstrates how variable declarations in adjoining function blocks can remain isolated. Our program features two distinct variables in adjoining blocks, both with the identifier, `i`.

Certainly, initializing two variables with the same identifier is not perfect programming practice. We did it here to illustrate as dramatically as possible Lattice C 2.0's ability to isolate blocks of code from one another.

A cleaner version of the program is shown in Figure 2. A third version of this same program, Figure 3, shows the kind of variations you can make and the fun you can have when you begin to fall in love with your Lattice C compiler.

When we began, we ran into a problem. Version 2.0's I/O functions, including the `stdio.h` definitions, have been upgraded. The upgraded I/O functions now run I/O for the console without the intermediate buffering stage. The new version lets `printf` send its characters immediately to the console whether the new line command is sent or not. The upgraded I/O functions do not acquire buffers via level 2 memory allocation, a change from previous versions. In the new version, the MS-DOS performs its own buffering. The I/O functions `open`, `read`, `write`, `Lseek`, and `close` are carried out more quickly. Large read/write data transfer operations also run faster.

Lattice C has always been a powerful compiler. But Francis Lynch does not believe in just "leaving well enough alone." With version 2.0, Lynch has made "what was" better. ■

```
#include        <conio.c>
main()

{

    int i,

    for(i=1, i<=3, i++){

        int i,

        for(i=1;i<=10, i++)

                putch(getch()),

        putch('\r'),
        putch('\n'),
    }
}
```

Figure 1: *A sample program showing how variable declarations in adjoining function blocks can remain isolated.*

```
/*      This program is called 'lendj c'        5 Jan '84
        It shows how C allows you to isolate variables in
        separate blocks   J is used in the outer block of
        the main() program and I is declared and used in the
        inner for-loop block
*/

#include        <conio.c>
                                /* Console input/Output source code library
                                   These functions putch() and getch() are
                                   found in this library   The #include macro
                                   statement brings in the source code file
                                   named 'conio.c' which is coepiled along
                                   with our program
                                */
main()
{

    int j,

    for( j=1, j<=3; j++) {

        int i,

        for( i=1, i<=10, i++)

                putch( getch() ), /* Get a character from keyboard 'getch()'
                                     and display it on the console 'putch()' */

        putch('\r'),    /* output a Carriage Return character to the console */
        putch('\n'),    /* Output a Line Feed character to the console       */
    }
}
```

Figure 2: *A cleaner version of the sample program shown in Figure 1.*

```
#include        <conio.c>
main()
{
    int i,      /*  declare variable used for loop count   */
    for( i=1 , i <= 3 , i++ )   /*  let's do this three times   */
        {
        int i,
        for(i=1,i<=10, i++)     /*  get and echo ten keystrokes   */
            putch( getch() ),
        cprintf(" You have now hit 10 chars and will start a newline \r\n"),
        }
    cprintf("\r\n The program has completed three loops "),
}
```

Figure 3: *A third version of the sample program shown in Figure 1, with variations.*

COVER STORY/STEPHANIE STALLINGS

C Into The Future

Tom Plum discusses the C language and explains why programmers are hopping on the bandwagon.

C language is fast becoming the programming language of choice. This comes as no surprise to Tom Plum, who has been working with C since 1976. His company, Plum Hall, Inc., headquartered in Cardiff, New Jersey, is blazing a trail in the use of C language and Unix-type operating systems. The company offers courses, such as a C Programming Workshop and an Advanced C Topics Seminar, for both individuals and companies. The company also publishes Plum's books, including *Learning to Program in C* and *C Programming Guidelines*.

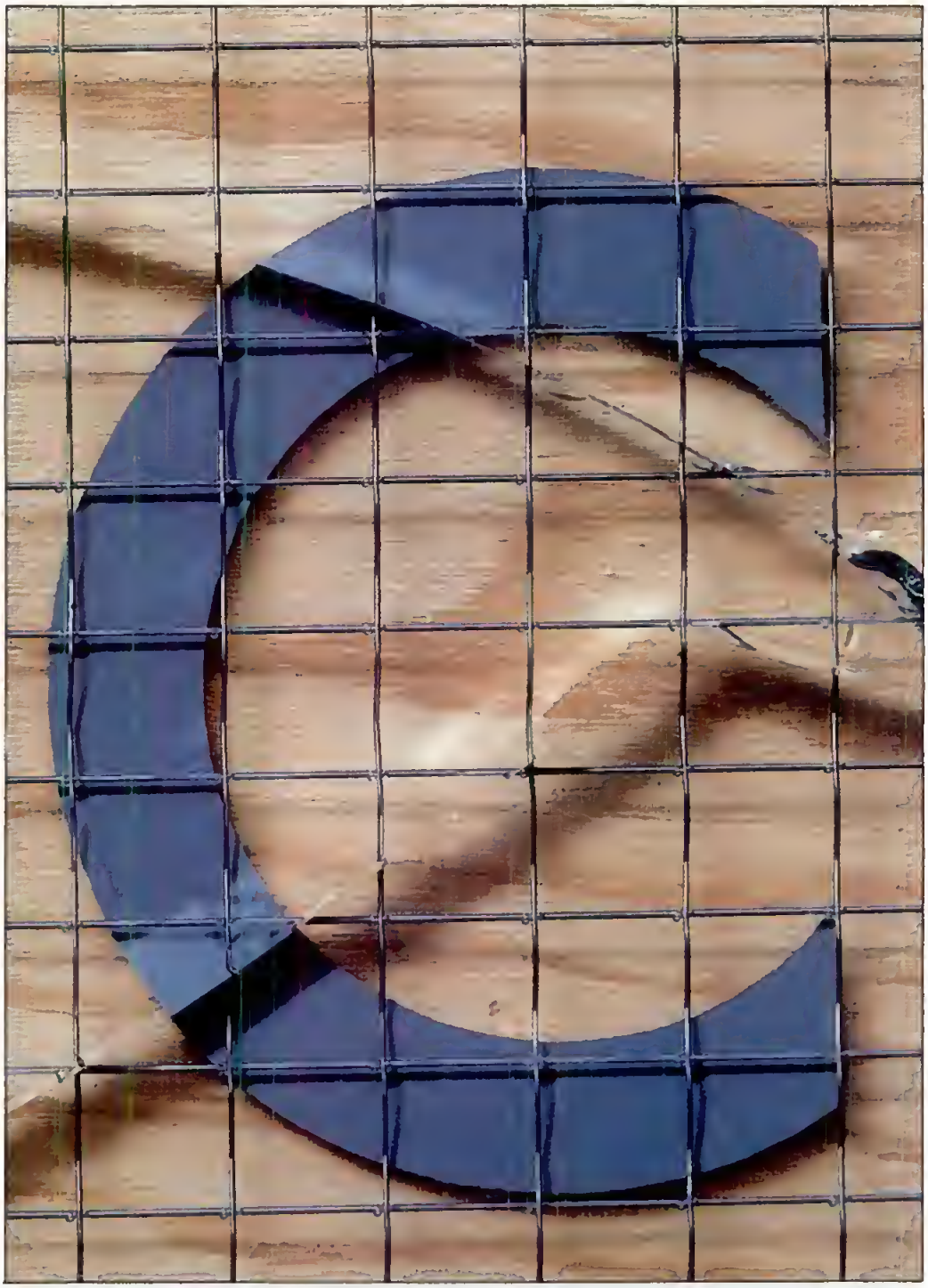
As far as Plum is concerned, almost anything now done in Assembler could be done better in C. He maintains that, in addition to being a practical production tool, C is also a pleasure to work with. It offers the high-level advantages of compact notation and structure, while still enabling the bit manipulations Assembler is known for. And it works on virtually any computer.

We asked Plum about learning C, its relationship to other programming languages, and about the language itself.

PC: Why did you decide to focus your work on C?

PLUM: *It's an exceptionally well-designed language. It was designed for practical work. Certain academic languages, Pascal, for example, were really invented to help students learn programming or to demonstrate certain theoretical*

Photographs: Geoff Spear



concepts about programming. They're fine for that, but they weren't designed for the production of professional programs.

C language was a pleasure to work with. Of course, there is a learning curve, just as there is with any language. There are concepts that you have to know in order to work intelligently with C language.

PC: Does C's reliance on symbols, unlike BASIC or COBOL, make it more difficult to learn?

PLUM: *There are really two separate questions. The first question is how easily can the general reader get the gist of a program? COBOL is the easiest language to understand, if you understand the concepts.*

The second question is how difficult is the language for the average programmer to write? I would say that C is somewhat harder than BASIC and somewhat easier than Assembler code. It's roughly the same as Pascal, because Pascal forces you to spend extra time learning how to work your way around the languages' inherent problems. I don't think C's use of symbols makes that much difference.

PC: Are people using C for new applications that other languages don't lend themselves to?

PLUM: *There's nothing that a person could do in C language that couldn't be done in Assembler. It's a question of degree of difficulty. Many applications that we now see people tackling in C language used to be done in Assembler code. That's a very important sign: people are moving out of Assembler code into a high-level language.*

PC: At the other end of the spectrum, would you also use C for things that are presently done in COBOL?

PLUM: *Applications that really belong in COBOL are not likely to be prime candidates for conversion to C language. COBOL is well suited to a certain class of business problems dealing with data in records, formatted fields of information, and interchange between various business-type programs. That's not C language's strong point.*

There's nothing you could do in C that couldn't be done in Assembler.

High C

PC: I asked that because I often hear people describing C as both a high-level language (like COBOL) and a low-level language (like Assembler). Just what do they mean?

PLUM: *They mean low-level in the sense that C is close to the machine hardware. Its code efficiency is similar to Assembler's. But, C is high-level because it's economical, just a few phrases command powerful computing tasks.*

PC: We've talked about C's strengths. Do you see any weaknesses?

PLUM: *Sure. You see, a language is just a tool to do certain kinds of jobs. As far as programming languages go, different ones are better suited for different applications. So it's always important to keep your purposes in mind.*

There's one generalization that you could make about C language right now: Anything that you would consider doing in Assembler can be done better in C. Assembler has been around since the beginning of computers, and people have gotten the impression that certain classes of problems have to be done in Assembler code. That just isn't true anymare.

Obviously, you can't simply throw Assember away; there will always be pieces of code that require some Assembler. But, by and large, the kinds of things that people used to do with Assembler can now be done with 95 percent, 98 percent, C language.

Portability

PC: Is C more portable—from machine to machine and from micros to minis to mainframes—than COBOL?

PLUM: *I understand COBOL portability is pretty good, if you follow the standards and don't get off into the extensions. The government and the users' groups have been heavily influential.*

I want to be precise about portability. Some people think that you can call a piece of code portable if you only have to change, let's say, 5 percent of it. With C language, the interesting thing about portability is that it would take me only a day to teach somebody what they need to do to insure the portability of their C language programs. Certain things must be considered to be assured of writing portable C.

PC: What kinds of things?

PLUM: *Every type of machine architecture has certain intrinsic machine dependencies. It's easy to write C language that doesn't depend on that stuff. You merely have to know what it is so that you don't use it. If programmers use common sense in putting their C language code together, they won't write anything that's going to be too difficult to port.*

PC: Do you have a specific course on portability?

PLUM: *Portability is part of a series of*

advanced topics in C language. We figure that when a person has become somewhat proficient in the use of the language, there's a whole series of topics that they really should understand in order to be a C language expert.

PC: What are some of the other topics?

PLUM: *Well, efficiency. That's one of the most important aspects of working in C language. We have a discussion of readability and standards. We have a section on the topic of packaging, which in the software business refers to different types of software modules—how things are put into libraries and directories. And there are hardware aspects of packaging. For example, people are involved with putting programs into ROM. We talk about all these issues from the standpoint of how C language works.*

Underlying Assumptions

PC: In your book *Learning to Program in C*, you say that "C has a concrete underlying model—the common architectural scheme of modern processors." I think an expansion of this idea would help people understand what makes C unique.

PLUM: *Assumptions about machine operation are built into C. Machines that actually work this way obviously tend to be good machines for C language. Machines that don't work this way tend to make C programs bigger and slower than they would otherwise need to be.*

C assumes byte-addressable memory, meaning that the smallest units of storage are units that are adequate to hold roughly one character. It assumes the presence of registers, special fixed areas of memory, easily accessed by the program. The machine should also support a stack type of mechanism fairly efficiently; C uses addresses on stacks to quickly locate data used by individual functions. C language assumes that the machine has a binary internal representation. Many languages don't care what kind of internal data storage your machine has. Also, you need to have bit operations in the hardware. In addition, C language assumes that zero (0) is a special case. The common manipulations against zero, such as testing for equal or not equal to zero, need to be efficient in your machine hardware.

"If programmers use common sense they won't write anything too difficult to port."

PC: Could the Unix and Xenix operating systems, which were developed concurrently with C, have been written in something other than C language, or are they optimized for each other?

PLUM: *Unix was originally written in Assembler code, but soon after was converted to C. If Unix had stayed on Assembler code operating system it would not have been moved onto so many different hardware systems. So one thing that is intrinsic to Unix as we know it is that it was written in a portable language.*

PC: What kind of data structures does C support? Is it flexible about handling whatever kind of files one might want?

PLUM: *You have to understand that all of C's capabilities, aside from the operators of the language itself, are provided by the subroutine library. Nothing is actually built into the compiler itself, as regards interaction with the environment. In the early years of C language, people tended to write their own subroutine libraries. But as things developed, the subroutine library that started with Unix Version 7 became more and more of a standard. This is likely to be standardized for all C compilers over the next few years.*

Today, when you buy a compiler you typically get a subroutine library with it. The Unix Version 7 standard library contains no provisions for file management. What you have are the building blocks: the basic low-level, direct-access functions and input and output functions. You have to put your collection of data access functions on top of them.

People have started to produce libraries for use with data-type applications. One of our instructors, David Graham, has created a library of data access functions for C language, with a complete repertory of ISAM, (Indexed Sequential Access Method) capabilities, plus all the utilities that you need. David has been working with compiler companies directly, so some of the PC compilers will have his software available as an option.

PC: You use a PDP-11, a minicomputer, don't you?

PLUM: *We run about 12 terminals off of our computers, so at the moment we can't support the office on a PC-type of machine; but we will have one pretty soon for various other purposes.*

PC: Will you use it for teaching?

PLUM: *The first thing that we have in mind for our PC is to develop some computer-assisted instruction. That's the next way we want to package our training for C language. There are no guarantees, but our plan is to try to have it ready by July. We figured that the PC was the right one to do first, because of its popularity.*

PC Interface

PC: Is there any difficulty with the interface between C language and the software

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packages available for the PC?

PLUM: *You can write interfaces to C language that are very nice and clean. It's a question of the market and whether somebody has already done it or not. There's no limit to the flexibility so far as the use of the subroutine library is concerned, but there's always a question as to whether somebody will choose to implement a new package with a COBOL interface or with a C language interface.*

PC: Are there any particular elements that you would look for in a C language compiler, such as the utilities subroutines we mentioned earlier?

PLUM: *It is important to look for the standard libraries. This whole area is so poorly standardized that it's difficult to comment. As far as I can tell, we're free from charlatans in the compiler business. Some compilers on the market have certain parts of the library and others have other parts; some are faster than others.*

PC: What operating systems will run C language?

PLUM: *All of them. There is nothing about C that ties it to any particular operating system. However, a piece of code does need to be written to support the C programs under operating system x. So, for any given compiler and operating system combination, someone may or may not have written the compiler to operating system support. For some operating systems it's a trivial few dozen lines of code, but for others, to take advantage of all the bells and whistles of the operating system, it can be a substantial effort. It's not a question of whether it can or can't be done; it's just a question of whether anybody has seen the market potential for doing it and gone ahead and done it.*

PC: Have the compiler manufacturers done this?

PLUM: *Almost all of the compilers that I know about support all of the popular flavors of operating systems.*

Large Packages

PC: Would the relative slowness of C compared to Assembler make a difference

for large software packages, such as those that do windowing, or integrated software packages, that have control programs?

PLUM: *Those kinds of applications are naturals for C. Usually, 10 percent of the code accounts for the majority of the execution cycle. You'll generally get a better product if you do those "hot spots" in Assembler code, the rest in C language.*

Past a certain point, Assembler code cannot support major changes. C language makes restructuring much easier than it would be in Assembler code. In general, high-level languages such as C, reduce the intrinsic complexity of a problem by 5 to 10 times, because of their more compact notation. Managing and modifying a complex system is much easier in high-level than in low-level languages.

I've had plenty of chances to see what C can do, and I'd like for people to know more about it. I'd dearly love to see someone create an interpretive C, just because of what it would do for the popularity of C language itself.

PC: What kinds of things do you think will be done in C in the future?

PLUM: *C will be used for applications packages and realtime and systems software—wherever efficiency and portability are important.* ■

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PC Program Editors: The Next Generation

IBM's ISPF, a sophisticated mainframe program editor, has spawned a litter of micro-sized offspring that bring power and convenience to data and source code manipulation on the PC.

Have you begun to feel that EDLIN is not the best way to enter programs? Does your program editor decline to help you set tabs for your COBOL program and politely demur when asked to insert code from another source into the file you're working on? And, if you're new to programming or if you write code infrequently, would you like some reminders of just what to say to your computer to make it do what you want it to?

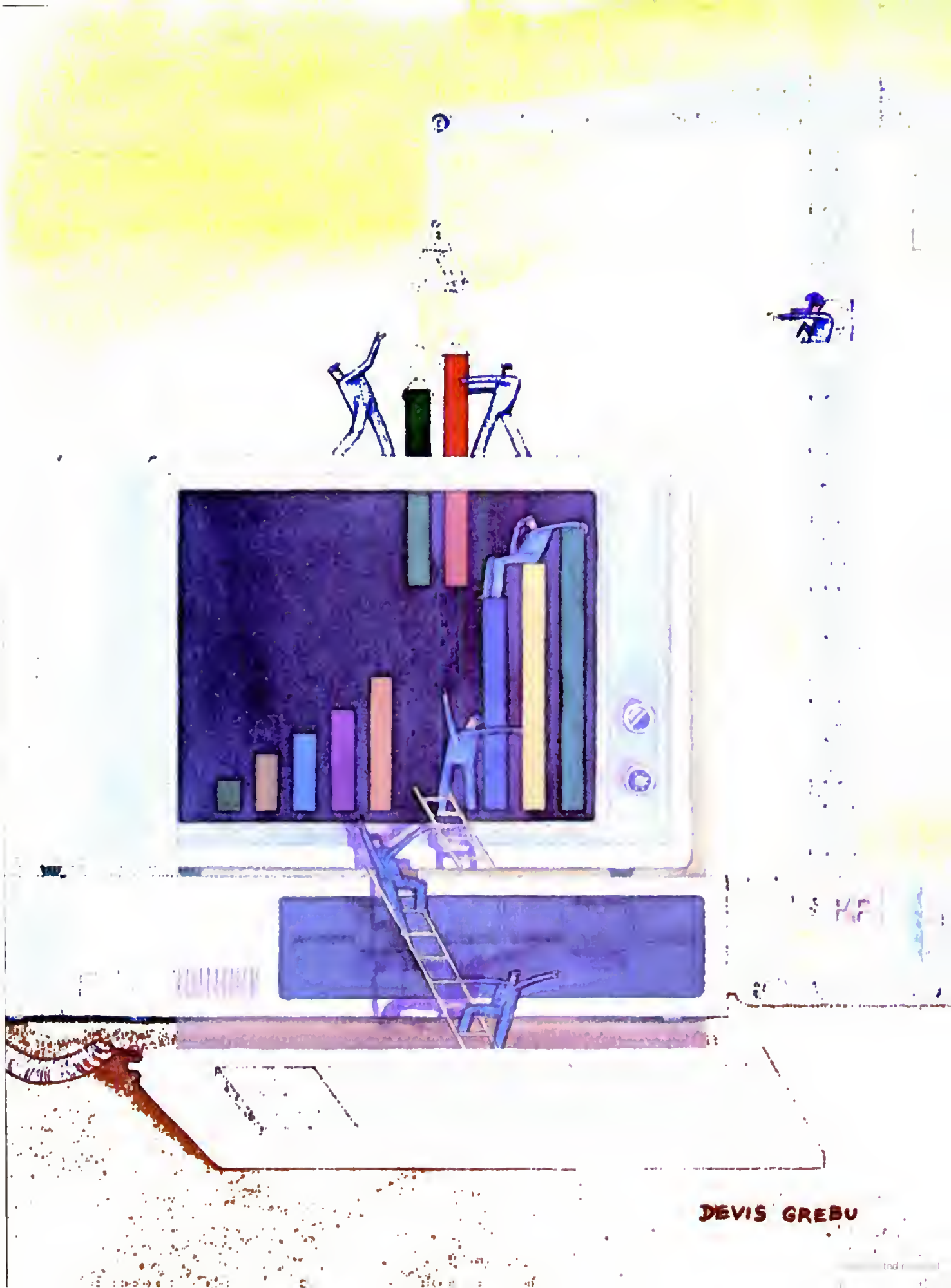
The new breed of editors is tailored to fill these needs. Just as word processors specialize in manipulating text quickly and easily, good program editors enable you to enter source code and data efficiently, without having to go through extra or awkward steps. A good program editor should gracefully accept code and data from high-level packages, such as database packages, which are not equipped with strong editors. And if, as mentioned above, you'd like a little help with the editing process and don't relish the prospect of spending the day thumbing through a manual, one of the new program editors now available might provide just the help you're looking for.

From Mainframe to Micro

Mainframe users get this help from the *Interactive System Productivity Facility (or ISPF)*. A variety of *ISPF*-like editors are now available for the IBM PC. Interactive capabilities range from giving you brief hints about which keys do what, to practically thinking for you. All of these *ISPF*-like program editors perform full-screen editing. They all have a formatted screen with areas that display status information and messages. They use a combination of editor commands, which are always placed on a preset command line, and line commands, which are entered in the margin of the line being changed. Beyond these common features, every program editor has unique features that give it a (sometimes quirky) personality of its own. Let's look at four representative *ISPF*-inspired editors, *SPF/PC* by Rogue River Software; *micro/SPF* by Phaser Systems, Inc.; the *Professional Editor* by IBM; and *TED* by Morgan Computing Company, Inc.

Since a good program editor should be able to manipulate code and data from many sources, the editors of *PC Magazine* devised a simple series of tests for the four editors. We used each one to create a new portion of code or a record of data; then, using the editor, the newly created code or data was combined with pre-existing code; the integrity of the code was tested by executing it; and the data was tested by passing it through a working program. This

Illustration: Devis Grebu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test was performed on each editor using a COBOL program, an Assembler program, a *dBASE II* command file, and *dBASE II* database (data) files of varying lengths.

SPF/PC, VERSION 1.6

Rogue River describes SPF/PC as being "made to look as much like IBM's *ISPF* as possible" and it will certainly look familiar to users of the mainframe system. *SPF/PC* is menu-driven, separating functions and subfunctions onto different menus. Unfortunately, some nonoperational functions are included on its menus. If you try to access the Upload/Download facility or the Macro Definitions screen, for example, you get a message instead of a function. (See sidebar, "What's Next" for more information.) A thoroughly modular design, *SPF/PC* enables you to perform operating system utilities, such as listing directories and renaming and deleting files, without leaving the editor.

SPF/PC requires some specific installation procedures in addition to the usual precaution of making a working copy of the software. The System Initialization Options Menu must be completed to indicate whether normally unused memory may be used by the editor. This increases the available workspace. Other system options, such as color and the alarm, are also set here. *SPF/PC* requires 80K of memory and is said to leave 20K to 30K of workspace in a 128K system.

After typing in *SPF/PC* at the DOS prompt, you are presented with the colorful Primary Option Menu and the options of Parms, Browse, Edit, Utilities, Communications, Command, Help, and Exit. To continue you must press two keys: the number or letter indicating your selection, and the Return key. If you selected Edit, by pressing the number 2, the next menu will request that you enter the file definition. You enter the drive, file name, and extension on three separate, labeled lines. There is little chance that you'll leave something out. Press the Enter key again to reach the edit screen. This is *SPF/PC*'s only nonmenu screen. The second line is the command input line for entering primary commands, while the status line at the bottom of the screen includes messages and tidbits of information. If you're at the edit screen and want to obtain a different file to edit, you have to leave the edit screen, go up one level to the menu, and enter the new file definition. You can always go up one level by pressing the End function key. This key gets much use and we would have appreciated a means of moving between secondary menus without having to pass through the primary one.

SPF/PC is menu-driven, separating functions and subfunctions onto different menus.

SPF/PC's Parameter Options Menu lists submenus for defining printer defaults and for changing the functions related to the function keys. You can streamline your program editing by redefining the functions with your most frequently used edit commands.

SPF/PC provides for nearly every conceivable manipulation of program text or data via primary command, line command, or function key. While these functions are extremely useful, sometimes they are also too complicated. *SPF/PC* automatically repeats the indentation or tabbing of the previous line. But if you want to start your current line to the left of the previous line, there's no reverse tab for moving to the left through your tab settings. *SPF/PC* claims to have a split-screen mode. It should rightly be called an alternating-screen mode since you actually must swap back and forth between two full screens.

The primary command CHECK scans for and displays any invalid ASCII characters in the file being edited. *SPF/PC* has a series of EXCLUDE line commands. These enable you to exclude groups of lines from viewing (or from global changes) and also allow you to peek at the excluded lines. The SHIFT line commands are useful if you forget to tab a whole series of lines and want to correct them in one command.

SPF/PC enables you to move and copy data between files with its "Move/Copy" utility and with the primary edit commands COPY, MOVE, CREATE, and TRANSFER. Unfortunately, *SPF/PC*'s primary edit commands require several steps. For instance, to create a new file from part of the current file you have to insert the CREATE primary command at the top of the edit screen, use the BLOCK COPY line command on the first and last lines of the program to be copied to the new file, and then go to a menu and give the new file definition. The TRANSFER command, which does the opposite, requires even more steps. *SPF/PC* does have a unique and convenient DOS Command Processor. You enter DOS commands on an *SPF/PC* screen and the program returns you to *SPF/PC* after it carries out the commands.

SPF/PC allows you to edit a portion of a file that is too large to fit into memory. You use the "Split" utility to divide the file into several files of a more manageable size. The Browse option also allows you to scan the entire large file and to print files that are too large to be edited.

The maximum record length that *SPF/PC* can handle is 240 bytes. In running our tests, the only time this was a problem was when we tried to read a *dBASEII* ASCII-formatted database file whose records were 250 bytes long. The screen displayed the message, Record Size Exceeds Maximum. We were able to edit a 230-byte record, but since it didn't wrap we had to scroll right in order to see the entire record. The BOUNDS and TEST FLOW line commands can be used together to make records wrap. Our tests of the *dBASE II* command file and the COBOL

and Assembler programs ran smoothly; in both cases, the automatic line numbering was helpful.

Hand Holding

SPF/PC practically holds your hand as it steps you through the menus, and it provides valuable assistance elsewhere as well. A fine, two-part tutorial is on the disk, accessible by editing the files Tutorial.doc and Tutorial.spf. A Help facility that gives an overview by function. The error messages on the screen are sometimes inadequate, but a thorough explanation often can be found in the "Messages and Codes" section of the manual.

The manual needs to be redesigned. It separates into the appendixes information that ought to have been included in the text. For example, Chapter 4 describes the System Initialization Options and the *SPF/PC* Parameter file, then directs you to Appendixes G and H for the details. The descriptions of the commands are sometimes superficial and often lack nitty-gritty examples. The BOUNDS command, which must be used in conjunction with other commands, is particularly difficult to understand. It also lacks an index. Finally, there are a number of typographical errors. At least it included a telephone number for getting immediate help.

SPF/PC is capable of guiding the new or occasional user of a program editor, but some upgrading of the manual would improve its ability to give a helping hand. Experienced users will miss the ability to alter the menu path and to enter file names directly on the edit screen.

MICRO/SPF, VERSION 2.0

Phaser Systems *micro/SPF* will also be quite familiar to mainframe *ISPF* users. This similarity makes it a good choice for anyone who programs both on a PC and on a mainframe using *ISPF*, since a new set of program editing rules would not be necessary. *micro/SPF* should be especially useful when a PC is linked to a host mainframe, since it supports the partitioned dataset-naming convention often used on mainframes. Unfortunately, *micro/SPF*'s emulation of *ISPF* also causes some problems.

An immediate problem is that *micro/SPF* requires a minimum of 320K, with 384K being the suggested amount. Many PC owners would have to increase their machine's memory in order to use *micro/SPF*. What is this program editor doing with all this memory? For one thing, it's supporting several different dataset-naming conventions: the usual eight-character file name, three-character extension dataset name, a quasi-partitioned dataset arrangement in which dataset members are part of a library, and a format in which the dataset name is automatically prefixed by a user ID. *micro/SPF* also uses some of that 320K to support a catalog management utility in which dataset names of the various types are cross-referenced. In addition, it allows detailed BROWSE commands. It requires much memory to create a mainframe programming environment.

Initialization Ritual

micro/SPF has a three-step initialization. After typing in SPF, you are prompted for a user ID, a word of your choice that tells *micro/SPF* to start the program and assigns function key definitions and dataset names. This is followed by an approximately 25-second wait while the editor loads. When loading is completed, a message informs you of the amount of memory (given in K) available for edit memory capacity and requests that you press the Enter key in order to obtain the

What's Next?

More improvements are in the works for upcoming versions of today's program editors.

The *M* in IBM could stand for "mum," because mum is the word on any possible future enhancements to IBM's *Professional Editor*. Rogue River Software, Phaser Systems, and Morgan Computing, however, were eager to share their plans for upcoming versions of their program editors. They all plan to release new versions in 1984.

The refinements planned for *SPF/PC*'s Version 2.0 include the use of path names in searching directories and a HEX EDIT command much like *micro/SPF*'s. It will be possible to define terminal characteristics such as terminal type, number of function keys, and screen format. Fulfilling promises made, but not kept, in Version 1.6, there will be an Upload/Download facility and a Macro Definitions menu similar to the ones in *ProfEd* and *TED*, allowing the insertion of text or commands. An optional Communications facility will also be available soon, enabling the transfer of data between a PC and a host, or among multiple PCs.

Version 3.0 of *micro/SPF* will contain a Local Operating System Command Processor, which, like *SPF/PC*'s DOS Command Processor, will allow the user to process operating system commands without leaving the editor. Terminal characteristics will be definable, as will list and log defaults. Version 3.0 will include simple text editing commands and the maintenance of dataset statistics such as version number and the number of lines modified. Utilities to list, rename, and delete datasets (which are listed on the screen, but do not function on Version 2.0), as well as library and Move/Copy functions, will be supported in Version 3.0.

The next version of *TED* will probably include a modified Split-Screen facility, in which one file can be edited while the other one is browsed. The Morgan Computing Company says that it is always interested in hearing users' suggestions for enhancements.—S.S.

Primary Option Menu. In a 320K system, the message told us that the capacity was only 36K. *micro/SPF* allows you to alter the path between the menus on many screens simply by typing an equals sign followed by the menu number. *micro/SPF* could improve this feature by allowing it on all screens and by displaying the menu or panel number on each screen. *micro/SPF* has a special menu for changing the functions related to the function keys and for associating primary and line commands with function keys. The edit profiles contain defaults for such editing features as tabbing, numbering format, and caps.

micro/SPF's extensive editing capabilities, its EXCLUDE, SHIFT, MASK, and RESET commands are essentially the same as those on *SPF/PC*. Its screen can be split or swapped at any line. Some *micro/SPF* commands include several options. The sequence numbering commands allow standard numbering in columns 1–6 and/or COBOL numbering in columns 73–78, as well as automatic or manual renumbering of lines. The FIND and CHANGE commands have subcommands that describe the character string as a prefix, suffix, or standalone word. The HEX subcommands will warm the heart of any Assembler programmer, since they will display the file in EBCDIC or ASCII representation, vertically or horizontally.

We reviewed an engineering copy of the new Version 2.0, and we were advised that it might still contain some bugs. We did have to swat a few. The TAB command caused the cursor to skip the designated column rather than stop at it. In some instances, the program was not able to scroll completely across the full scroll field. The CREATE and REPLACE commands, which move lines from the current file to another file, beeped at us and displayed the message, "Disk I/O Error." Yet the MOVE and COPY commands, which bring lines into the current file, worked fine. The function key defaults are associated with a user ID; however, we discovered that any function key definition changes we made had disappeared the next time we signed on. The people at Phaser assured us that these problems would be fixed before the retail release.

micro/SPF has a utilities menu which includes utilities to list, rename, and delete datasets and to move and copy datasets. When you attempt to access these functions, however, a message tells you that they are not yet available. They are expected to be completed for Version 3.0. (See sidebar, "What's Next" for more details.) *micro/SPF* has an additional utility, "Catalog Management," which is operational. It maintains the internal dataset name cross-reference.

micro/SPF handles fixed or variable length ASCII records of up to 255 characters. The maximum file size depends on how much edit memory capacity remains after loading. All of our tests ran smoothly. Even the test of a *dBASE II* database file ran without a hitch since *micro/SPF* was able to accommodate *dBASE II*'s maximum line length of 254 characters.

The *micro/SPF* manual is well-meaning but disorganized and incomplete. For instance, the commands are not grouped alphabetically; instead, they are organized by option: Browse, Edit, or Utilities, and

Split Decision on Split Screens

Some program editors support split screens better than others.

You assemble or compile your program, and the resulting source listing show that you have five errors. How do you keep this error information in front of you at the same time that you display your program so that you can fix the errors?

You could print the source listing or the screen showing the errors, then compare this to the displayed program. Or you might keep the source listing on the screen and use it to mark the offending lines on a previously printed copy of the program, which you will then edit and correct. What you really need are two screens.

The split-screen feature available on some editors is the equivalent of having two screens side by side, enabling you to view two files simultaneously. After naming the files, function keys are used to split the screen into two parts and to swap the cursor between the two subscreens.

This feature simplifies comparisons. You can view your program on the top part of the screen as you read the source listing errors on the lower part and correct mistakes as you go. Similarly, you can use the cross-reference listing or the map while viewing the program, and you can compare two versions of a program without having to print them. You can use one portion of a screen to create a new file while retaining a display of an existing program.

Micro/SPF's split-screen feature is the most flexible. The portion of the screen that can be allocated to either file is variable, and the active part of the screen can be used for any menu or function without disturbing the other part. *SPF/PC*'s split-screen capability should really be called alternating screens—the two files or menus being viewed are both allocated a full screen, so that is is necessary to alternate between them. *TED* does not handle split screens, but its EASY REFERENCE command can be helpful. It tags a page of a file, then brings in a second file for editing. The page in the first file can still be viewed, because the EASY REFERENCE command stores the marked page in a separate area of memory. Split screens are not supported by *ProfEd*.—S.S.

within option by type. Even the "Command Summary," Appendix B, follows this format. This necessitates thumbing through the manual or looking up the command in the table of contents or index. And the index has some lapses. It gives the page number for the TABS primary command but not for the TABS line command. It does not mention the SHIFT commands. Since the commands are arranged by option, each page of the command section should indicate which option it refers to. There is a similar problem with the error messages. Some of the messages we received could not be found in Appendix A—"Messages," which also was not in alphabetical order.

ProfEd uses color, highlighting, and blinking to get the user's attention and help distinguish areas of the screen.

There is also a tutorial, accessible from the primary option menu, which gives a quick overview of the commands. The Help facility expands upon the short error messages that appear on the right half of the first line of the screen. Pressing the F1 key will, in some cases, provide a longer, clearer message.

micro/SPF's ambitious goal of being a microcomputer replica of IBM's *ISPF* has caused more problems than it has solved. The major problem is memory requirements. In a 320K system with one disk drive, we found that when we went from one option to another—say from Edit to the Function Key Definition menu—we often had to remove our scratch disk and re-insert the *micro/SPF* disk. Otherwise we aborted and found ourselves in DOS. The program is slow even when it operates properly. It took approximately 25 seconds for *micro/SPF* to load on our system and about 4 seconds to change screens between options. A third problem is an over-eagerness to offer all of *ISPF*'s features. Appendix C describes future enhancements as if they already exist. It would be nicer if the authors had waited for the facilities before they started telling you how useful they are.

PROFESSIONAL EDITOR, Version 1.0

IBM's *Professional Editor* (ProfEd) is characterized by its extensive use of the function keys. With multiple sets of function keys, it replaces many editor commands, line commands, and menu screens with one or two keystrokes. *ProfEd* also allows the creation of one's own data macros, which can be called with a single keystroke. *ProfEd* requires 96K for the standard version, though 128K are recommended. It runs all functions except the Data Macro Definition Menu and the File List Menu on just 64K.

ProfEd uses color, highlighting, and blinking to get the user's attention and distinguish areas of the screen. This is important since some parts of the screen are crowded, especially the text margins and the function key labels across the bottom.

The user has four different sets of function key definitions. The function key sets take a little getting used to, but they're worth the trouble, because they make so many functions available from the current screen. The F1 key is used for changing key sets—each time you press it the functions of all the other function keys change and the new labels appear on the bottom line of the screen. For instance, if you want to retrieve a previously used command from the command stack, press the F4 key in function key set 0. If you'd now like to retrieve lines that were accidentally deleted, press the F1 key until key set 1 appears, then press the F6 key to undelete. Practice makes it easier to find the particular function you're looking for.

While *ProfEd* uses function keys for many editing procedures, it uses menus for initialization procedures. The first menu you see when you type in EDIT is the Primary Options Menu. You type in the file definition before choosing an option. The Primary Options Menu uses a special version of function key set 0; it would make more sense to give this key set a different number. This initialization function key set accesses the other initialization menus. The Tabs and Mask Options Menu creates an input mask—characters in specified columns that will be placed on every new edit lir he File List Menu contains directory i. ıation on whatever files you choose.

The most interesting menu is Data Macro Definition Menu. Here, you can redefine the alternate alphabetic and numeric keys so that, on pressing the key, a character string will be inserted into your Edit file. The key can also be associated with a file name, so that pressing the key will insert the contents of that external file into the one you're editing.

One awkwardness of *ProfEd* is that in order to use the command line located near the bottom of the screen you must first press the "swap" key, F2, in function key set 0. This alternates the cursor between the text and the command line. To go to the last line of the current file, you would have to make this swap, then type B on the command line. To edit the last line, you have to swap back. Mitigating this, many operations, such as scrolling, deleting lines, setting tabs, and printing, can be done in different ways. For example, a file can be scrolled by using the four scroll keys in key set 1 or with the PgDn and PgUp keys on the numeric keypad. Screens can be printed using the Shift key and the PrtSc keys, using the Print and Eject function keys, or using commands for printing groups of lines.

While *ProfEd* doesn't have a split-screen mode, it can split one line into two, or gather several lines into one. It can translate upper and lower case back and forth. A total of eight Search and Change function keys provide forward or backward movement in a file by seeking the first or last occurrence. Changes can be

restricted to column boundaries.

As we found when running our tests, it is possible to merge files and create a new file of extracted lines without leaving the edit screen. Merging would have been even easier if we could have specified line numbers; it's surprising that there's no automatic line numbering on *ProfEd*.

ProfEd handles large files very smoothly. It reads in the portion that will fit and informs you of how much this is. You then use the NEXT, GET, and PUT commands to read segments of the file in and out for editing. Unfortunately, *ProfEd*'s maximum record length is only 140 characters. When *ProfEd* attempted to read a 150-byte *dBASE II* ASCII-formatted database record, this limitation prompted the message, "WARNING 1 lines were SPLIT due to excess length. Press any key to continue." A split record was created and the GATHER command was needed to reunite the sections.

A respectable word processing facility is included in *ProfEd*. The manual claims *ProfEd* isn't a complete word processor, but basic features, such as automatic word-wrap, paragraph indentation, justification, margins, and centering, make it quite usable for small tasks.

The manual has only a few lapses. The tutorial lessons are helpful as far as they go, but they should have explained more of the features. First-time users will feel a bit lost. *ProfEd*'s manual is excellent, with an easy-to-follow format, complete descriptions, and the thorough indexing that we have come to expect in the IBM PC manuals. Screen messages are long enough to be helpful. In Appendix A of the manual, each screen message is followed by a diagnosis and a prescription.

Meet the Editors

Here are the vital statistics on the four program editors reviewed in this article.

Name	*SPF/PC, Version 1.6*	*micro/SPF, Version 2.0*	*PROFESSIONAL EDITOR*	*TED, Version 1.2*
Manufacturer	ROGUE RIVER SOFTWARE 2822 Tahitian Ave. Medford, OR 97501	PHASER SYSTEMS, INC. 24 California St. San Francisco, CA 94111	IBM	MORGAN COMPUTING CO. 10400 N. Central Expressway, Suite 210 Dallas, TX 75231
Help Line	(503) 779-3002	(415) 434-3990	IBM Product Center or authorized dealer	(214) 739-5895
Where Buy	direct order	authorized dealer or direct order	IBM Product Center or authorized dealer	direct order
List Price	$155	$450	$130	$95, $10 for updates
Memory Required	80K RAM	320K RAM	94K RAM standard, 64K RAM minimum	128K RAM
Maximum Line Length	240 characters	255 characters	140 characters, longer lines are divided	75 characters, longer lines wrap onto next line
Maximum File Size	files larger than available memory can be split into several smaller files	depends on available memory	files larger than available memory are automatically segmented	640K or 7,000 lines of 75 characters each
Characterized By	menus	commands and menus	sets of function keys	commands

There is no Help facility, and perhaps *ProfEd*'s best recommendation is that it doesn't need one.

TED, Version 1.2

The manual describes *TED* as being an attempt ". . . to provide the finest professional programming editor possible at the lowest practical cost. . . ," so perhaps we shouldn't have been surprised to find that *TED* is in black and white. After this initial letdown, though, *TED* began to live up to its billing. There are no menus. It uses a formatted edit screen that accepts file commands and line commands. Yet this relatively simple presentation makes it possible to edit, merge, and create files swiftly and easily.

TED requires at least 128K of memory. The file size it can handle depends on the amount of memory available; 128K allows for a file 820-lines long, with each line being 75 characters, while 640K enables *TED* to edit a 7,000-line file. A continuation character (inserted into column 5 with a combination of the Alt key and the L key) effectively removes record length limitations. *TED* requires no installation unless you want to load it from a drive other than A. If so, you must use DOS DEBUG to alter TED.EXE according to the directions. This can slow you down if you're not comfortable with Assembler.

TED uses two-character file commands and, usually, one-character line commands. The function keys come preset with the most often used file commands, but all of the function keys can be reprogrammed with commands and/or text. Function key usages are automatically saved in a file; the manual suggests having

Name	*SPF/PC, Version 1.6*	*micro/SPF, Version 2.0*	*PROFESSIONAL EDITOR*	*TED, Version 1.2*
Split Screen	alternating screens	yes	no	no
Browse	yes	yes, with several subcommands	no	no
Automatic Numbering	yes	yes, with several subcommands	no	yes
Programmable Keys	yes	yes	no	yes
Ease of Moves and Copies Between Files	several steps required	fewer steps required	easy	easy
Macro Facility	no	no	yes	yes
DOS Utilities	list directory; rename file; delete file; DOS Command Processor	no	no	no
Additional Printing Features	yes	no	yes	yes
Special Features	elementary word processing can check for invalid ASCII	choice of dataset naming convention; HEX commands	sophisticated word processing; can translate letters to and from upper and lower cases	can insert time, date and version number with each update of file

several such files for different purposes.

TED's scroll amount can be set with the PS file command. *TED* also has an EASY REFERENCE file command with which you enter a line number you'd like to refer back to. Later, when you'd like to see this line and the page following it, press—and hold down—the Ctrl key and the A key. In addition, once you've marked a line of a file with an EASY REFERENCE command, you can bring a second file into memory with the IF command and still refer back to the marked portion of the first file. Pressing Ctrl and R gets rid of any screen changes since the last entry. It must also be used to cancel incomplete line commands, since they cannot be gotten rid of by retyping the line number over the unwanted command. Unwanted line numbers can be removed by pressing the Alt and N keys.

TED's INSERT FILE commands are powerful and easy to use. INSERT TEXT merges lines from another file into the one you are editing. INSERT FILE turns the new file into the main file. You save the newly edited file with the SF file command by simply typing in a new file definition if you don't want to use the old name. After saving the file, be sure to clear memory with the XX file command; otherwise, your next INSERT FILE command will merge the incoming file with the one still in memory. Since *TED* has line numbers, you can merge a part of a file in a single step. *TED* also has a special INSERT EDLIN file command that converts the tab character to spaces.

TED has a unique extra touch. It can automatically enter the time, date, and version number each time it saves a file.

We read an Assembler program, which had been created elsewhere, into *TED* with the INSERT FILE command. The program appeared on the screen with a non-ASCII tab character in place of each tab spacing, so that the label, operator, and operands on a line all ran together. We got back the tab spacings by rereading the Assembler program with the INSERT FILE command. The tests using the COBOL program and the *dBASE II* command file ran without problems. *TED* had no trouble editing long ASCII-formatted *dBASE II* database records. The full record appeared on the screen, where it was broken into 75-character lines with continuation characters. Since *TED* claims to translate non-ASCII data into IBM display symbols, we gave it an additional test. We attempted to edit another *dBASE II* database record that had not been ASCII-formatted. *TED* displayed the file's name, but no data appeared on the screen.

> Unfortunately, ProfEd's maximum record length is only 140 characters.

Chapter 1 of the manual contains *TED*'s tutorial. It is a straightforward introduction to *TED*'s commands and simple procedures. The contents of the manual are concise and complete, but it should be in a ring binder so that you can add updates. On disk, the tutorial and the manual's section on editor commands can be accessed with the F1, F2, and F3 keys. The hints that appear on the screen are explained in Section 4 of the manual.

TED also adds a few printing facilities. It allows you to print all or part of a file, with or without line numbers.

TED does not entice the user with bright colors or elaborate screen formats but, in a quiet manner, it is a straightforward and efficient program editor.

Comparing the Editors

You may have noticed that we did not include a BASIC program among our test programs and files. We felt it would be pointless to do so since none of these editors can reset the line numbers in the GOSUB statements when lines are added to or deleted from BASIC programs. *SPF/PC*'s DOS Command Processor allows one to get around this by stepping out of *SPF/PC* to use the BASIC editor, then stepping back into *SPF/PC* to use other editing features. All of the editors can read BASIC programs created elsewhere if those programs were translated into ASCII code by using the A option when they were saved. Additionally, all the editors can create working BASIC code.

Our simple tests show that all four editors can manipulate ASCII code and data files, though there are limitations regarding line lengths. *SPF/PC* has an absolute maximum of 240 characters per record, while *micro/SPF* can handle 255. *ProfEd* splits records that are over 140 characters in length and requires that you gather them into their original lengths before using them. *TED* puts no restrictions on line lengths. On *SPF/PC*, *ProfEd*, and *TED*, the longest response time was for saving a file, usually from 3 to 4 seconds.

Choosing among these four ISPF-like editors should be based largely on your experience and programming style. *SPF/PC*'s menus will prevent you from leaving out any necessary steps and at the same time give you quick access to DOS utilities. Its great strengths are somewhat counterbalanced by the multiple steps required to merge files and the absence of a genuine split-screen facility. The additional features of *micro/SPF*, such as alternate dataset-naming conventions, a *micro/SPF* catalog, and detailed BROWSE commands, do not sufficiently differentiate it from *SPF/PC*. Unless one particularly needs these additional features, possibly for interacting with a host system, it is hard to justify *micro/SPF*'s large size and slow speed. The learning time is a little longer for *ProfEd* than it is for *SPF/PC* or *micro/SPF* because of the various function key sets. Even taking into account this extra effort, *ProfEd* is still quite helpful to the new or occasional user and allows one to do many things without changing screens. *TED* provides the fewest automatic features, which means that the user must understand what is being done. For such users, *TED* may be the most efficient editor of the bunch. ■

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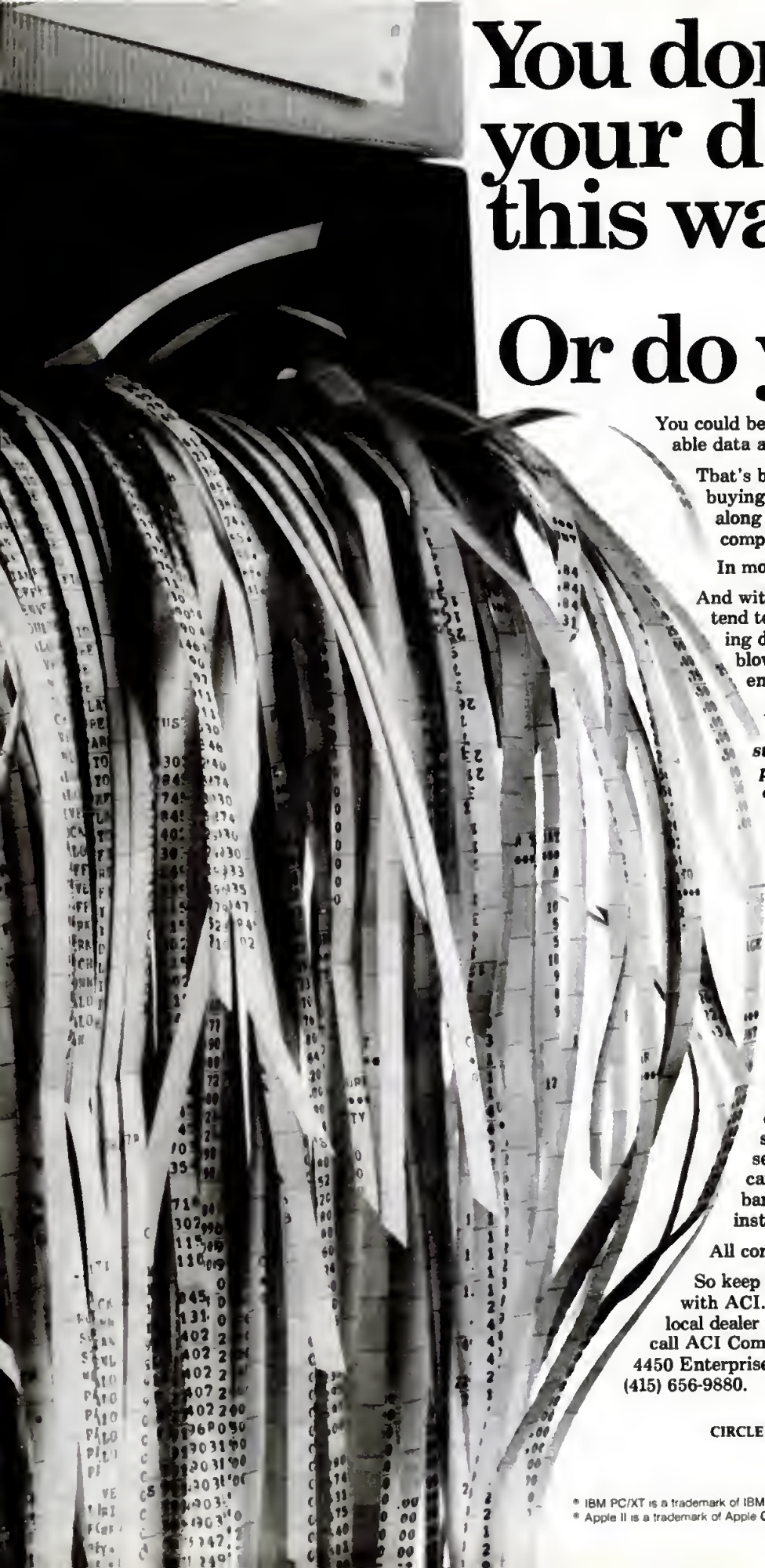

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Packet Switching Puts You In Touch

Packet switching holds its position as the premier method for remote computer communicating because it's fast and reliable. It also happens to be relatively inexpensive.

One of the most important developments in computing was the advent of time-sharing, a system that enables several programs to run at a time. This is done on one computer by making clever use of the "pauses" that occur when one part of a computer is busy but another is idle. Equally important in advancing computer use and in driving computer usage costs down has been the development of a communications technique called packet switching. Just as time-sharing permits several programs to run on a single computer at the same time, so packet switching enables many users to communicate simultaneously, often at great distances, on a single packet-switching network, of which there are many. (For more information, see the accompanying sidebar, "The Packet-Switching Bandwagon.")

A variety of physical pathways—ranging from lines leased from AT&T and other carriers to satellite and microwave systems, and so forth—tie users into a single network.

But the physical links are not the essential element in a packet-switched system. Successive messages do not necessarily travel via the same physical route. In fact, the term "packet switching" (PS) indicates that what's being switched around are packets—electronic blips. The precise physical circuits they travel are not very important; only the network addresses of sender and recipient are. If I'm sending a message to the Wyoming State University computer from Boston, the first part of the message might go via Chicago; when the next part is ready to be transmitted, it might go via St. Louis, if the Chicago route is full.

In terms of hardware, the heart of each network is a linked system of microcomputers. For instance, one of the nation's most widely used packet-switched networks, Telenet, consists of microcomputer nodes manufactured by GTE Telenet

Communications Corporation and located in major cities (see Figures 1 and 2). The essential function of the microcomputers of the Telenet system is to break up every message into a discrete package and then to track that package as it travels between sender and recipient. The special way that messages are packaged and then tracked is what makes packet switching economical. In effect, messages are placed on the same telephone line, but at different times. That is to say, they are phased. Imagine, for example, that at time 00:00:00, a message from sender 1, bound for recipient 1, goes on the line; at time 00:00:12, perhaps, a message from sender 2 bound for recipient 2 goes onto the same line. By looking at the coding on the packages, Telenet can determine that these are really two different conversations and not mix them up.

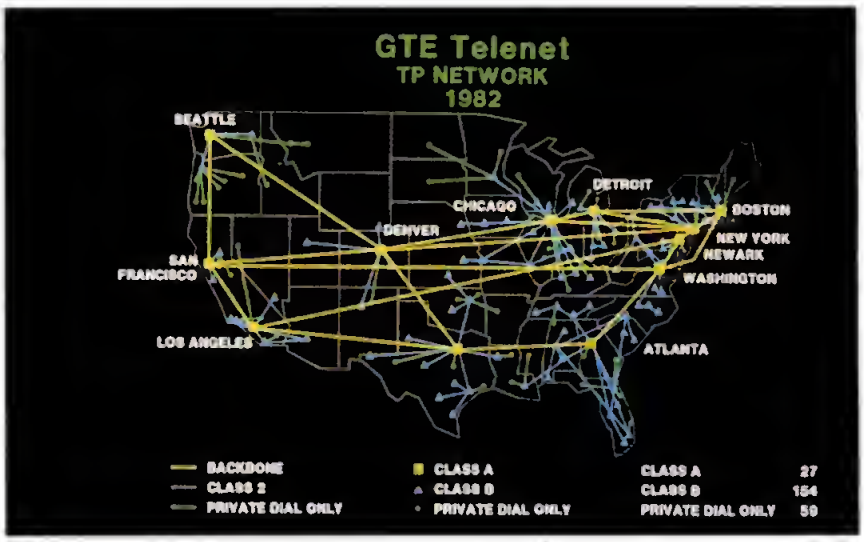

Figure 1: *A map of the GTE Telenet network in the continental United States. (Copyright 1981 GTE Telenet Communications Corporation)*

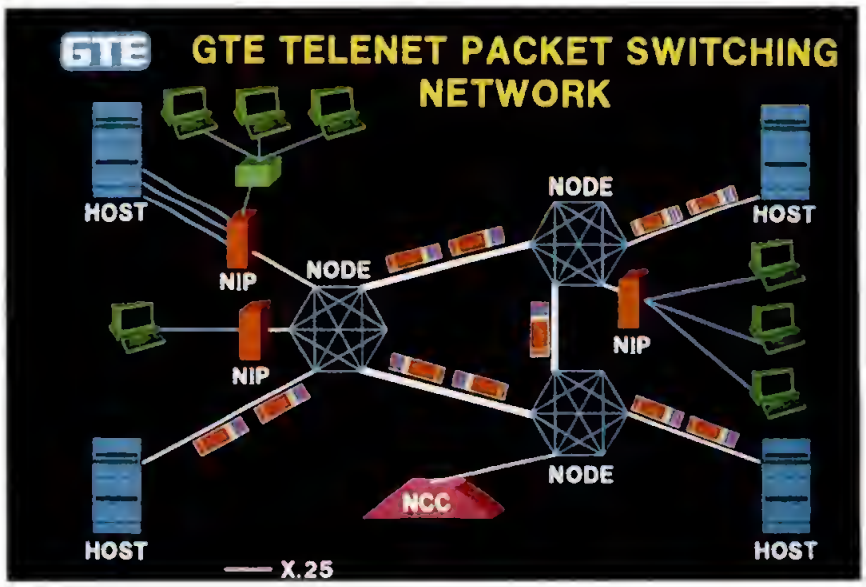

Figure 2: *Nodes and hosts in the GTE Telenet packet-switching system. (Copyright 1981 GTE Telenet Communicotions Corporation)*

A Defense against Error

The codes are added by Telenet's node processors at the beginning and end of each message to indicate the sender's and the recipient's respective network addresses (see Figures 3 and 4). They also contain a special check called a cyclical redundancy check (CRC), a calculation used by Telenet to ensure that a message arrives intact at its final destination. The check is performed because static or transmission errors anywhere along a line can cause an error that would otherwise go undetected; a cyclical redundancy check is the most elaborate and foolproof defense against error since it is unlikely that static could change both a character in a message *and* the CRC in such a way that the two would continue to agree. If an error has been detected, there is a retransmission. The check happens between each pair of sending and receiving nodes in the system. Thus—in theory, at least—it's impossible (or at least very difficult) for a message to arrive garbled.

The careful checking of messages and their phased transmission along a single path are not the sole reasons for packet switching's preeminence as a communications technique. Packet switching displays certain basic features that account for its wide success. For one thing, packet switching is robust; that is, it does not easily succumb to unplanned outages. It has high survivability. If a disaster were to strike a conventional telephone company office in, say, St. Louis, phones in the area might be cut off from the rest of the network, and calls in progress would be lost. In packet switching, theoretically, nothing would be lost. If node 2 were to suddenly stop working when node 1 is transmitting, node 1 would get no acknowledgment; node 1 would then, presumably, try a different route.

Another factor that makes packet switching work so handily is its almost total transparency to users. The system is all but invisible to the thousands of computer or terminal users who daily log on to

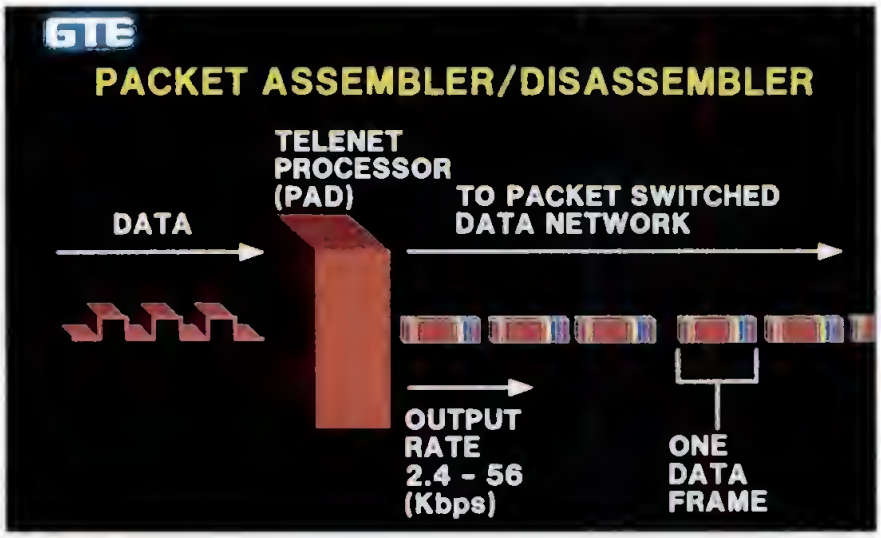

Figure 3: *The transformation of data from a continuous to a packet-switched format via a Telenet processor. (Copyright 1981 GTE Telenet Communications Corporation)*

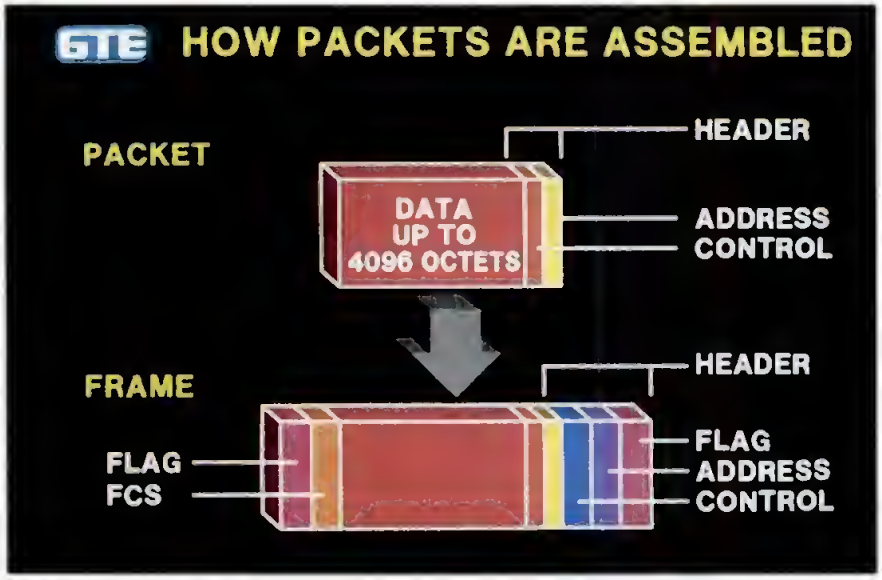

Figure 4: *The component parts of an assembled data packet in the GTE Telenet packet-switching system. (Copyright 1981 GTE Telenet Corporation)*

remote service such as The Source and CompuServe. One of the key ingredients in the system's transparency is the handling of language protocols. For instance, the protocol used in the IBM PC is called ASCII, but another language protocol called EBCDIC (pronounced "Ep-si-dick") used by other computers or terminals can access packet-switched systems with no effort required by the user. The necessary protocol translations are done by the hardware. Consequently, accessing Telenet merely requires the same hardware and software used for general telecommunications work—basically, a smart or dumb terminal or a personal computer, almost any telecommunications software, and a modem.

In addition to being transparent, packet switching is also fast. The extra steps necessary to sign on to a packet-switching system are so quick and easy that they go unnoticed by most users. Major cities almost always have both 300 and 1200 baud facilities, although the higher speed may not be available in areas with lower traffic volumes. Once data get inside a packet-switching system, speed distinctions disappear: Transmissions that enter the system at different speeds travel at the same rate (often 50,000 baud).

Another reason for packet switching's success is the simple, straightforward procedures it establishes for users. For the sake of simplicity, we'll describe the sequence of events for users of the Telenet system. The user places a regular telephone call, which is answered by a sophisticated microcomputer. In response to the computer's familiar tone, the user turns on the modem. Lights then appear on the modem to indicate that a communications link has been established.

The system answers by identifying itself with a signal that says TELENET and with the address of the node that's been accessed. In effect, this is Telenet's way of saying "Hello."

The user then enters two carriage returns, these two alone are sufficient to tell Telenet what kind of computer is being used. Telenet then responds with an at sign (@), which is its way of asking, "To whom do you wish to be connected?"

Hello Laramie

Let's say you want to access the Wyoming State University (WSU) computer in Laramie, Wyoming. Telenet's numbering scheme consists of an area code and a two- or three-digit code for the particular computer; this, in effect, is the computer's telephone number. (Telenet publishes a list of these numbers for the use of its subscribers. We're not giving away any secrets here; in any case, the computer underground has many copies of the Telenet directory floating around.)

If there are available lines to the host requested by the user, Telenet will make

(continued)

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The Modem Connection

If combined with the right software, a modem can link the PC to distant mainframes.

An essential element in packet switching systems, the modem (modulator/demodulator) can enable the PC to communicate with virtually all mainframes. With the appropriate communications software, the modem allows the PC to send and receive data over ordinary telephone lines and hence to access any mainframe that has telephone input/output (I/O) facilities.

The software used to communicate with a mainframe can be designed in any one of three ways. First, high-quality packages allow the PC to function as a "smart" terminal, from which the user can send files to the mainframe from a disk connected to the PC ("uploading" a file to the mainframe), or retrieve files from the mainframe and store them on the PC on either floppy or hard disk ("downloading" a file from the mainframe). In addition, the PC can be used to edit data displayed on the screen, which can then be transferred to the mainframe or stored on floppy disk on the PC.

Alternatively, the PC can be converted into a "dumb" terminal, that is, a terminal incapable of uploading or downloading data files. A dumb terminal can only use programs and data that have been stored on the mainframe. This approach (see Appendix F of the IBM BASIC manual) fails to take advantage of the full power of the PC and is not recommended if another communication method is feasible.

A third approach is to use software that for all practical purposes transforms the PC into another type of terminal. Packages are available to make the PC "look like" a Tektronix series 40 terminal, a VT 100 terminal, an IBM 3270 terminal, or several other commonly employed terminals. In general, these packages enable the PC to use the protocol developed for the terminal being emulated.

Why is a terminal emulator useful for PC–mainframe communication? In the case of the IBM 3270 terminal series, for instance, direct connection to IBM mainframes is typically accomplished by running high-speed coaxial cable straight from the 3270 terminal to the mainframe (assuming, of course, that the mainframe 452is within reach). The cable allows very rapid data communication using special 3270 error-checked transmission protocol and forms an excellent high-speed link between the terminal and the mainframe. A PC emulating a 3270 terminal can enjoy the same advantages.

The 3270 terminal series includes a number of "smart" features like built-in editing commands. Of course, since they are simply terminals, the 3270 series lacks the ability to upload or download files to the mainframe; a true 3270 emulator also lacks this ability. Nonetheless, a company with personnel already trained to use a 3270 terminal might choose to emulate this terminal on a PC to take advantage of this training. In addition, if direct connection is not possible, communication can be accomplished with a modem.

Certain terminals are designed to operate with specific mini- and mainframe computers. The VT 100 is a terminal specifically built to communicate with the Digital Equipment Company (DEC) line of computers. If it is necessary to communicate with a DEC computer from your PC, one obvious solution is to emulate a VT 100 terminal and take advantage of its full screen-editing capabilities.

However you use the PC to communicate with a mainframe—as a dumb terminal, a smart terminal, or a terminal emulator—if you need to use phone lines for the connection, the best way to communicate will be to use the PC as a smart terminal transmitting via a modem. The next problem, therefore, is how to configure the PC and modem to ensure accurate data transmission.

Communicating via a Modem

A modem is a device that converts computer-generated data into tone signals for transmission over ordinary telephone wires. For our purposes it is not necessary to describe the actual operation of the modem in detail. It is sufficient to note that there are standard methods of converting the data output by the PC into signals that can be sent over telephone wires, received by a remote computer, and then decoded into the original data.

The use of a modem to send files from one computer to another makes it possible to prepare data on the PC for mainframe processing and avoid the costs of using the mainframe as a data editor. Once the mainframe has finished running the program, data can be sent back to the PC for further processing, which might include printing, graphing, or additional editing. The cost of transmitting data is very low compared to the high cost of file storage and manipulation on a mainframe.

The data transmission protocol between the PC and the mainframe must be established correctly before the PC and

(continued)

(The Modem Connection continued)

mainframe can be connected. Communication using a modem involves serial (asynchronous) transmission of data, which simply means that data are sent out as a string of bits, rather than simultaneously in 8-bit increments, as in parallel data transfer.

The data are transferred as a series of 1s and 0s over the telephone line. Depending on the protocol, every 7 or 8 bits represent a character. For example, if the communication mode is 7 bits per character, the binary sequence 1001010 would be read as ASCII character 74, which is the letter J. Since we are limited to only 7 binary bits in the 7 bits per character transmission mode, the largest decimal number that can be represented is 127, binary 1111111. If we use 8 bits per character, it is possible to transmit all 255 characters in the IBM ROM. (For a listing of the character equivalent of each of the 255 codes of IBM's version of ASCII, see Appendix G of the IBM BASIC manual.)

If we wanted to transmit the word JUMP using 7-bit serial communication, we would need to send the bits 1001010101010111001101101000O to the receiving computer. The problem here is that there is no indication of which bit starts the transmission and where the transmission ends. The use of start and stop bits solves this problem. In most protocols, there is 1 start bit and either 1 or 2 stop bits that appear before and after each 7- or 8-bit character sequence. In a system using 7 bits per character, with 1 start (S) bit and 1 stop (T) bit, the word JUMP would then be transmitted as S1001010TS1010101TS1001101TS1010000T.

Notice that for every 7 bits of information, we have actually transmitted 9 bits: the 7 bits per character, 1 stop and 1 start bit. In addition, there is often 1 parity bit attached to the end of each 7-bit data sequence. The parity bit, either a 1 or 0, depends on whether the system is running even, odd, space, mark, or no parity, where parity is a conventionally established mathematical relationship between the parity bit and the bits of the corresponding character. For instance, suppose we want to transmit the character J, binary 1001010, using 7 bits per character, even-parity protocol. With even-parity protocol, the sum of the data bits plus the parity bit should be even. Because the 7 data bits sum to 3, an odd number, the parity bit must be 1. Thus, the entire character string will be S10010101T, since start and stop bits are ignored when determining the value of the parity bit. If we were using odd-parity protocol, the sum of the data bits plus the parity bit should sum to an odd number. Hence the parity bit would be 0, and we would transmit S10010100T.

The space parity protocol always uses 1 as the parity bit, whereas the mark parity protocol uses 0. If we were communicating with 8 bits per character, there would be no room for a parity bit in each 8-bit sequence; hence we would specify the no-parity-bit protocol. Notice that in every case discussed, we have a total of 10 bits per character, the usual number.

The Purpose of Parity

The purpose of a parity bit is to protect the integrity of data being transmitted over a noisy telephone line. It is easy to imagine that in any 7-bit string, a single bit could be changed from a 1 to a 0 during transmission. If this were to happen to the character J, we might transmit the binary sequence S10010101T using even parity, but the receiving computer might receive S10000101T, in which the middle 1 has been incorrectly transmitted as a 0. The string is now decimal character 66, the letter B. The parity bit helps us to avoid this type of error.

As soon as the sequence arrives, the receiving computer adds up the value of the data bits and parity bit (3 in our hypothetical example). Since we are using even-parity protocol, the receiving computer is alerted that an error in transmission has occurred and rejects the character. It then sends a signal to the sending computer to resend the data, which are only accepted when the parity test is successful. Since the most common error is reversal of 1 data bit per character, this scheme detects better than 90 percent of all data transmission errors.

There are several other data transmission checking schemes, including the XMODEM protocol used by many microcomputer networks. In all cases, it is only possible to communicate using a specific protocol if both the sending and receiving computers have the appropriate software. This is simply a question of communication software: The modem faithfully converts digital data into telephone tones and reconverts tones into data, but interpretation of the decoded data is up to the software. Before attempting to use a special communication system, make sure that both computers are using exactly the same protocol. This includes using the same parity protocol and the same number of bits per character. If either of these parameters is incorrectly set, only garbage will be transmitted. Each mainframe system has one or more established communications protocols, so it is always necessary to check with the system operator before attempting to sign on. My local university mainframe, for example, uses 8 bits per character, no parity, 1 stop and 1 start bit for 1200 baud communication, and 7 bits per character, 1 stop bit, 1 start bit, and even parity for 300 baud communication.

Baud refers to the transmission speed, or baud rate, which is simply the total number of bits per second transmitted through the serial port. The PC is capa-

(The Modem Connection continued)

ble of transmitting at 110, 150, 300, 600, 1200, 2400, 4800, or 9600 baud. Most modems, however, are only capable of transmitting data at 300 baud, or 1200 baud if you buy a high-speed modem. Speeds higher than 1200 baud require more sophisticated error checking than a simple parity bit scheme because of the noise on telephone lines. For applications requiring the transmission of large amounts of data to and from the mainframe, I strongly recommend a 1200-baud modem. In those instances where 300-baud communication is needed, a simple flick of a switch will permit most 1200-baud modems to operate at the lower speed.

A 300-baud modem transmitting 300 bits per second and handling data that require 10 bits per character will transmit 30 characters per second. This means that a screen with an 80×25 display having up to 2,000 characters when full can be transmitted in about 70 seconds. Of course, much of the screen may consist of blank space with no characters present, in which case the transmission time will be less. At 1200 baud, the same screen will be transmitted in less than 20 seconds, a considerable improvement. Transmission speed increases dramatically if the PC is connected directly to the mainframe with coaxial cable and a terminal emulator program, reaching as high as 9600 baud.

The Mainframe Connection

The first step in connecting your PC to the mainframe is to call up the director of the mainframe facility to find out what protocol the mainframe supports. You should determine the baud rate for telephone connections, the number of stop and start bits, the number of data bits per character, and what parity protocol is used. In many cases, the facility will support both 300- and 1200-baud communication, using different telephone numbers for each.

Once you have this information, you should talk to the phone company representative if you have a telephone network in your office. It is imperative to isolate data transmission from normal telephone conversations, either by bringing in a separate data line or by installing isolating circuits in your existing telephone network.

> Full duplex mode, allows the user to see each character as it is transmitted.

If you have one of the special long-distance packages offered by companies such as MCI, you will normally have to predial a special code to obtain access to the MCI long distance network. If you are using an autodial modem like the Hayes Smartmodem, you simply include the entire dialing sequence in the autodialing directory. If you are using a manual dial or acoustic modem, you simply dial the number as you would normally, then place the phone in the cradle.

A software package either supplied with the modem or obtained from a software supplier generally sets the serial communication parameters for the PC. Initialization of the serial port is accomplished by the DOS MODE command, described in the PC-DOS manual. The command allows the serial port to be configured correctly for communication with any mainframe, provided the user knows the connect speed (baud rate), parity protocol, number of bits per character, number of start bits, and number of stop bits. The program *PC TALK-3*, available for a nominal charge through Freeware, Headlands Press Inc., Tiburon, California, allows the user to configure the serial port in a menu-driven style and provides many other outstanding communication features for the IBM PC.

Once you have set the communications parameters, it should be a simple matter to dial up the mainframe and connect the PC via the modem. If you are unable to connect, double check the telephone number, parity setting, baud rate and bits/character. If the connection is good but no characters appear on the screen, the likely cause is the echo setting for your modem.

On some mainframes, every character you transmit is retransmitted back to the PC through the modem. Known as full duplex mode, this allows the user to see each character on the screen as it is transmitted to the mainframe. Some systems operate in half duplex mode, in which case the transmitted characters are not echoed back to the PC. In order to see anything on the screen, it is necessary to turn the echo feature of your communications package on. Occasionally you will see two copies of each line on the screen. This could be the result of spending too many hours at the monitor, but more likely you have the echo feature on and the mainframe is communicating in full duplex mode, giving you two copies of each line. To cure the problem, simply turn the echo mode off.

Once you have established the connection and everything looks normal, you can then begin to send and retrieve data. If the telephone line is noisy owing to heavy use or atmospheric disturbances, you may notice that data transmission is degraded. If it really is a noisy line problem, save your work, hang up, and redial. This problem is apt to be more common at 1200 baud than at 300 baud, so another option would be to redial at 300 baud if possible.

—Daniel Holzman

A Communications Checkup

The cyclical redundancy check generates the check digit by a complex version of casting out nine's.

The idea of redundancy checking can be compared to the check digits used on most credit cards and traveler's checks. A simple form of check digit, or redundancy check, is called "casting out nine's." Suppose you have traveler's checks in sequence: 00124, 00125, 00126, and so on. If you're using a check digit based on casting out nine's, add up the values of the individual digits and subtract the sum from 9. For example, 1+2+4 = 7; 7 from 9 leaves 2, which becomes the check digit—thus, the traveler's checks, in sequence, would actually be numbered 00124-2, 00125-1, 00126-0, and so on. A two-step calculation is necessary to establish the check digit for 00127: 1+2+7 = 10; 1+0 = 1, 9−1 = 8. The full check number would thus be 00127-8. If you discover a check numbered 00124-5, it would be immediately apparent that something is wrong—perhaps a counterfeiter failed seventh grade math.

The Packet-Switching Bandwagon

The lucrative field of intercomputer communications is tempting many firms to compete.

The following packet-switching systems are now being offered.

ADP Autonet
Automatic Data Processing Autonet
175 Jackson Plaza
Ann Arbor, MI 48106
(313) 769-6800

Cylix
RCA Cylix Communications Network, Inc.
800 Ridge Lake Blvd.
Memphis, TN 38119
(901) 761-1177

Net 1000
AT&T Information Systems Inc.
1 Speedwell Ave., room 813e
Morristown, NJ 07960

Telenet
GTE Telenet Communications Corporation
8229 Boone Blvd.
Vienna, VA 22180
(800) 835-3638

Tymnet
Tymnet, Inc.
2710 Orchard Parkway
San Jose, CA 95134
(408) 946-4900

Uninet
Uninet, Inc., A United Telecom Company
10951 Lakeview Ave.
Lenexa, KS 66219
(913) 541-4400

—H.A.K.

the connection. The user must then go through the WSU log-on procedure and give the correct password and ID (assuming the host computer is set up to require these). Once the user's log-on attempt has been successful, it appears the user as if he or she is connected directly. With no apparent delay, the user transmits messages, and the computer responds.

Telenet's billing procedure spares many of its users from ever seeing an itemized bill.

Telenet's billing procedure spares many of its users from ever seeing an itemized bill. Although some services attached to Telenet, such as Dialog Information Services, Inc., include separate Telenet charges in their monthly bill, others such as the Dow Jones News/Retrieval Service, absorb Telenet charges in their general fee structure.

Low Cost

But just because the charges can't be seen doesn't mean they go unnoticed. One of the reasons why packet switching has been accepted so widely as a communications standard is that charges are low compared to conventional phone service. Telenet is called a usage-sensitive service: The amount of time the service is used accounts for the bulk of the charges, whereas conventional telephone service is both distance-and time-sensitive. Maximum charges on Telenet are $8.00 an hour, regardless of the distance. In contrast, maximum charges for a daytime call to connect a Boston computer user with one in Wyoming, for example, can be as much as $29.40 an hour. These are the kind of savings everyone can understand, and they have made packet switching the technology of choice in worldwide computer communications. ■

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IBM EYE/FRANK J. DERFLER, JR.

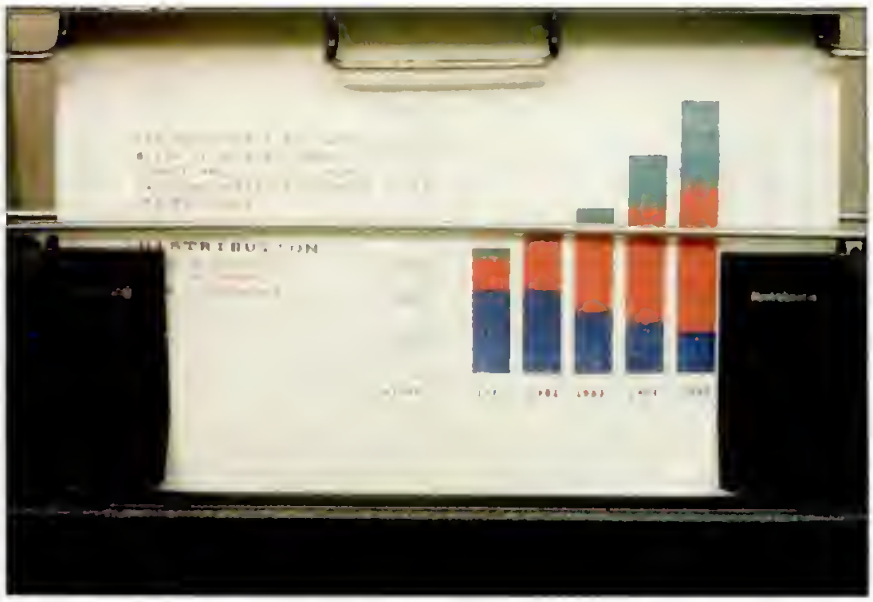
PC's Powerful Cousin: The IBM CS9000

Designed for lab use, this micro can monitor and process data from a variety of inputs.

...published material

While wandering among the conversational huddles that formed after a recent PC Users Group meeting, I focused in on some hardware gurus who were standing in a corner of the room impressing each other with their knowledge of technical acronyms. One relatively quiet gentleman took advantage of a microsecond pause to ask if anyone knew how he could read standard PC files into the 96-track-per-inch disk drives used on the IBM CS9000. The CS9000? The air of confidence that had been so strong among the gurus disappeared like smoke on a windy day.

The machine that caused such consternation is an honest but little-known IBM product with some capabilities that go far beyond those available in the standard IBM PC family. The CS9000 (short for Computer System 9000) is a desktop computer with the same keyboard as the standard PC, but it has the ability to carry up to 5 megabytes of RAM and to stuff 640,000 bytes of data on a 5¼-inch diskette. It has a multitude of I/O ports and an internal four-color printer. Special function keys are a part of the video display screen and the CS9000 can be equipped with a large panel of touch sensitive keys that can be programmed for a variety of functions.



The optional printer designed for the CS9000 mounts internally and can produce graphic images in three colors plus black. Program commands can be used to change the color of the print and even to print text vertically.

Designed to Meet a Need

The CS9000 was not born in the sunshine of Boca Raton with the more publicized PC clan; rather, it was developed in Danbury, Connecticut, by a subsidiary of IBM called IBM Instruments, Inc. It wasn't designed to run *WordStar* and *1-2-3*, and it would choke on PC DOS, but it has the potential for being a very unique product in the market IBM designed it for and, I think, in another area with potentially spectacular growth.

The CS9000 was designed as a laboratory tool. It has the ability to simultaneously monitor and control a number of events going on outside of its own cabinet. The need to process data from several sources at one time and to hold large programs that can react quickly to events calls for a more powerful microprocessor than the 8088 used in the PC. With this in mind, the IBM engineers designed the CS9000 around the Motorola 68000 microprocessor. The 68000 has the ability to process data from several different sources nearly simultaneously, and it is commonly found in multiuser, multifunction computer systems. (Two of these 68000 processors *are* used by IBM in the new PC XT/370 microcomputer.)

The 68000 uses a 16-bit data path, but it processes data internally in 32-bit chunks. This combination of data widths is similar to the 8-bit external/16-bit internal technique used in the PC's 8088 processor, and it provides great processing power with moderate costs for associated memory and I/O integrated circuit devices.

The standard operating system for the CS9000 is called IBM Computer System Operating System or CSOS. With a catchy name like that, it is almost a relief to report that IBM has announced that it will also provide the Xenix operating system, which is a Microsoft product derived from AT&T's Unix operating system. No specific Xenix software is available for the CS9000 yet, but the move to provide a Unix-type capability can be regarded as a significant acknowledgement by IBM of the impact this operating system (and possibly AT&T) is expected to have in the multiuser market.

For the time being, however, several useful CSOS programs and languages are available for the CS9000. The operating system includes a full screen editor, assembler, and link editor. The BASIC language package designed for the CS9000 is unique in my experience because it is a BASIC interpreter with the ability to compile. In other words, you can run any program you write through the interpreter as you develop and trim the source code, but when you have the source code ready, you can issue a COMPILE command and BASIC will produce an encoded program that runs more efficiently and can't be listed. More traditional FORTRAN and Pascal compilers are also available for the system.

A Scientific Subroutine Library runs under CSOS and can perform very powerful operations, including statistical analy-

sis, linear algebra, and quadrature computations. This package is a very large file of both simple and complex analysis programs. These programs can be called from FORTRAN application programs you write (BASIC and Pascal calls will be available in the first quarter of this year) and used to examine data collected by the CS9000 from a variety of sources in the outside world.

Data In and Out

To function well as a laboratory tool, the CS9000 was designed for efficient data acquisition and processing. The system board is equipped with three RS-232C serial ports, a parallel port, and an IEEE-488 interface. The IEEE-488 bus (also known as the HPIB or Hewlett-Packard Interface Bus) is used on some Commodore computers, some Hewlett-Packard computers, and on the flashy Grid Compass, but its major use is in the interconnection of high data rate instruments, sensors, and test equipment. This bus system includes sophisticated protocols that can make a certain device either a controller, listener, or talker. Data can be queued for transfer, and large amounts of information can be exchanged and processed very efficiently. IEEE-488 is a perfect system for monitoring laboratory experiments or processes, capturing data, and ordering changes to certain operations based on programmed conditions.

A wide variety of analog-to-digital converters are available for the CS9000 that can sense the strength of a signal like an audio tone, adapt to it, and provide the computer with digital information about the characteristics of the input. Different converters are available for a wide range of frequencies, amplitudes, and sensor connections.

Internally, the CS9000 moves data using the Motorola VERSAbus. This is a structure of internal wiring that is often used with the 68000 processor. The VERSAbus has become very popular in the multiuser microcomputers that are challenging the market once held by Digital Equipment Corporation and other minicomputer manufacturers.

The processing elements of the computer are contained on one large processor board that is full of components. A hard disk controller and extra memory can be added by using a five slot VERSAbus expansion card that plugs into the main board. The system board also holds 128K of erasable-programmable read only memory (EPROM) chips, a sophisticated video graphics display system, and the interfaces for the human input devices.

> The IBM engineers designed the CS9000 around the Motorola 68000 microprocessor.

Data from Humans

Although the CS9000 was designed to gather information from a great many automated data sources simultaneously, it also has some very nice features for taking inputs from human beings. The best thing about the control system is that in most applications you can forget about the keyboard, because the CS9000 has two easy ways for people to command the computer: touch keys on the monitor and touch keys in a special panel. If the software is written properly, the user will never have to wonder about the status of CapsLock, where the Enter key is, or what the keys with the funny arrows are for.

The area under the screen on the CS9000 contains ten keys that can be used for almost any program functions. The labels on the screen above these keys can be changed at any time, so the user actually has a great variety of options to choose from.

But—as if this isn't enough—the CS9000 also has a keypad containing 57 touch-sensitive keys. Each key in this pad is large and can be labeled with either big letters or detailed information. Some keys contain light-emitting diodes controlled by the program that can be used to direct the user's attention to certain functions. If software is written to make good use of this keypad, technicians and researchers need not become typists to use the system efficiently. Indeed, the CS9000 Basic System Unit packaged and priced by IBM does not include the keyboard, but it does include the keypad. This is just the kind of capability and easy-to-use interface that will make microcomputers useful in jobs and environments that have not taken well to earlier computer designs.

The CS9000 is also well equipped to present data for human consumption. The monitor has a green-on-black display with excellent clarity. It can display graphics with a resolution of 768 by 480 pixels and characters using a 7 by 14 dot format. This is more dense than the rarely used 640 by 200 black-and-white graphics available from the standard PC's Color Graphics Card or the 7 by 9 character format available from the Monochrome Display Card. The display screen can be tilted, swiveled, and locked into the desired position.

The optional internal color printer is located between the monitor and the computer unit. Although this location necessitates some contortions to remove the paper, the design successfully reduces the amount of space the system takes on a crowded laboratory table. The printer uses standard 9½- by 11-inch sprocket-fed paper and provides a red, green, blue, and black ribbon that can change color on a character-by-character basis.

What Can You Do With It?

The IBM CS9000 is certainly well designed for its role as an information gathering and processing system. In the laboratory it would be a workhorse, but there are at least two other applications that should interest people who are developing new high-technology products.

First, the CS9000 could be an excellent device to use in the automation of manufacturing processes. The wide variety of

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inputs it can accept, its friendly ability to work with humans, and its great speed and processing power make it very suitable for manufacturing applications.

But the application that really interests me is the use of the CS9000 for home automation. Like the computer in Arthur

Home automation can now be taken out of the steel-and-rubber grip of futuristic robots and put into a computer.

C. Clarke's story *2001: A Space Odyssey*, I want my system to monitor events in my household, tell me things I need to know, and take care of things when I'm not around.

Home automation can now be taken out of the steel-and-rubber grip of futuristic robots and put into a computer. With electronic sensors and actuators spread throughout the house, the ability to monitor and process both analog and digital data, large memory capacities to hold big programs full of alternative actions, and simple controls for inexperienced persons, the CS9000 is perfect for the job.

I am happily planning to integrate a CS9000 with entry and fire sensors, thermometers, humidistats, furnace and water heater controls, the telephone, the doorbell, a voice synthesizer, and other devices. The software designed to accept the data is not too difficult to write, but the IF THEN statements in the action program seem to go on forever. If you are interested in marketing a home automation system, the CS9000 could be the perfect machine for you. But until I see a good commercial product, I'll keep working on my hobby. Meanwhile, I wonder if the gurus at the PC Users' Group will know where I can get the chips to do a 5 megabyte expansion of my RAM? ■

CS9000 Price List

Here's how the CS9000 and its options add up.

IBM Instruments Computer System 9000
IBM Instruments, Inc.
Orchard Park
P.O. Box 332
Danbury, CT 06810
(203) 796-2500

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CIRCLE 739 ON READER SERVICE CARD

Both *Decision* and *Decision-Analyst* can help the user make a decision about practically any problem that requires the consideration of multiple, quantifiable factors. For instance, you could use these programs to make a decision about which photocopier to purchase. In this case, you would consider such factors as cost, features, performance, and the availability of service. Since all of these factors are not of equal importance, you would have to assign various weights to each one. When all of these factors are scored, either program will compute the results and rank the factors according to criteria and weighting. A similar business application might entail choosing investments. Here, you would need to consider capital appreciation, safety or risk, leverage, liquidity, and interest income.

Decision and *Decision-Analyst* accomplish essentially the same task, though they approach the decision-making process in entirely different ways. You will have to decide—by considering multiple, though not strictly quantifiable, factors—which program will best suit your needs..

Decision, from Once Begun Computations, in Searsport, Maine, is a no-frills package with a no-frills price tag of $20. It assumes you want help making a decision and little more. You boot it up, it asks you what you want to decide, prompts you for your choice and attributes and generates the results. If you want a hard copy, use the Shift-PrtSc key combination. The program doesn't generate reports or provide any narrative. It simply provides a quick computation of the results.

In fact, the program is so simple that it may not be satisfactory to some users. In order to obtain successful results, you need to understand the process of assigning different weights to the various factors. *Decision* offers no assistance here. Therefore, if you weigh the factors arbitrarily, the results will be arbitrary, too. The data disk provided with the program does contain a number of examples, including some that demonstrate the impact of weights and how different ratios affect the outcome. However, these offer

little help to the inexperienced decision maker.

On the brighter side, *Decision*'s use of color is impressive. The implementation far exceeded my expectations of such an inexpensive program. The program is bug-free and runs as the documentation says it will. It did not, however, recognize the presence of a second disk drive, and swapping disks became a real nuisance. The manufacturer would be well advised to address this disk drive problem in its next program update.

A Research Partner

Decision Analyst, which is manufactured by Executive Software, in Dover, Delaware, and retails for $139, takes a much more comprehensive approach. The program's tutorial-type manual presents guidelines that help you to assign weights appropriately. Also, the program includes a help facility (see Figure 1) that is accessible most of the time.

Rather than simply providing the decision as a screenful of information, *Decision-Analyst* provides the user with a completely documented report that could be presented to higher management.

Where *Decision* helps you decide the right course, then leaves it up to you to sell that decision to management, *Decision-Analyst* looks as though it were designed for the middle manager, who has to both chart the right course and justify that decision in a professional format to higher management.

Thus, *Decision-Analyst* is not just a computerized decision making aid, it is also a research partner. It accepts more than just key words and weights, which encourages an orderly thought process.

Where *Decision* leaves you to correctly assess all of the pros and cons of a decision, and to ensure that the decision-making process is complete. *Decision-Analyst* guides and prompts the user through a much more detailed decision-making process (Figure 2). Also, by accepting narrative inputs, the decision-making process becomes self-documenting, which allows a third party to review the entire process for flaws, errors, omissions, or misassumptions.

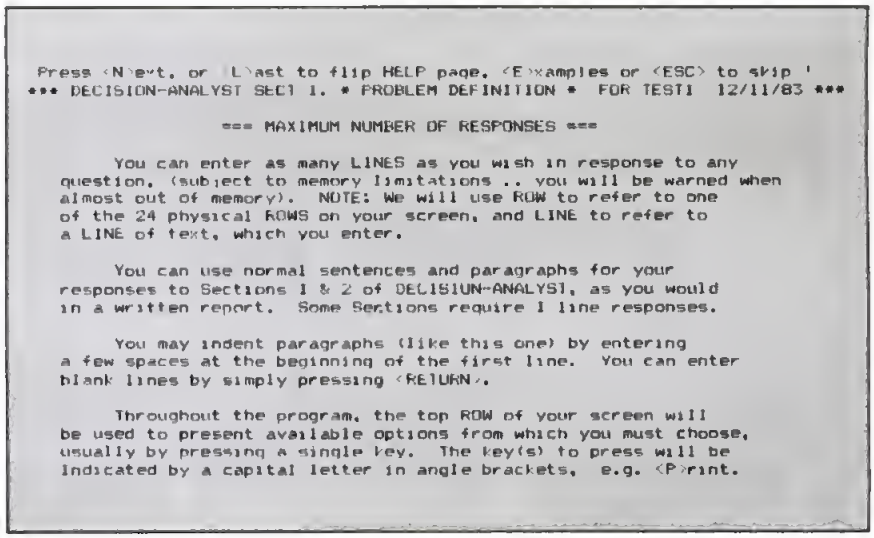

Figure 1: *A help facility screen from* Decision-Analyst.

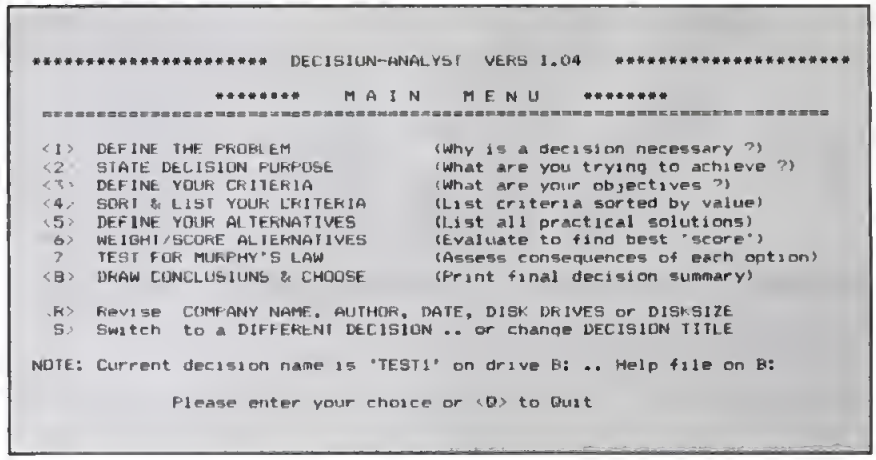

Figure 2: *The main menu from* Decision-Analyst *illustrates the program's detailed decision-making process.*

Additionally, *Decision-Analyst* provides a Murphy's Law analysis that lets you inject up to 12 potential problems to see how each affects the final analysis. This is an impressive feature because in business, decisions are often validated by this very process.

Executive Software says that *Decision-Analyst* is a direct result of the author's experience running a manufacturing company. That experience is reflected in the software's well-thought-out approach. Where *Decision* simply helps a user reach a decision, *Decision-Analyst* attacks the entire problem. Not only does it help the user chart the right course of action, it also helps him study alternatives and more completely analyze the situation.

Decision-Analyst does not use color, which seems odd considering the extensive popularity of color monitors. Although this omission does not detract from the package's ability to do the assigned tasks, at this price I expect color from a program.

Decision-Analyst uses two disk drives and has excellent error-recovery tech-

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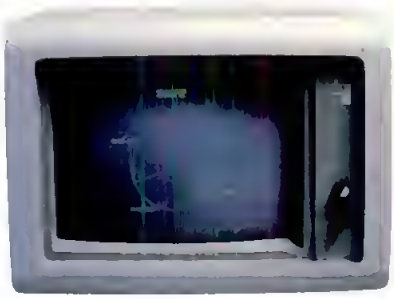

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Parallel port	Standard	Standard	Standard
Serial port	(2) Standard (one std./one opt.)	NA	NA
Clock/calendar w/battery	Standard	NA	NA
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384K memory w/RAM drive	Option	NA	NA
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- The MultiMate™ Program
- The VisiCalc® Program
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niques. It often refused to accept illegal entries. The program also fails to make use of the PC's function keys—an indication that implementation on the PC is not as extensive as it could be.

While the use of narrative-type entries is an asset to *Decision-Analyst,* the method for making these entries leaves much to be desired. Executive Software opted for a *WordStar*-like set of editing commands (Figure 3) that does not recognize such amenities as word wrap, a tab key, cursor arrows, and a delete key. The folks at Executive Software show no evidence of having seen a PC keyboard.

Neither *Decision* nor *Decision-Analyst* are copy-protected, which means both can be used with a hard-disk system. Executive Software's product-use agreement requires *Decision-Analyst* users to report and pay additional fees based upon the number of user stations that allow concurrent user access. Executive Software allows one backup copy at a time to be used, but places no restriction on the creation of additional backup copies if the originals become unusable. Once Begun Computations, on the other hand, has more of a "Freeware" philosophy. The *Decision* license allows the use of the product in one machine only and places no restriction on the number of backup copies. A user may transfer the license to another person provided the new user agrees to the terms of the license. There is no charge for the registration transfer. A licensed *Decision* user can make copies (Figure 4) for other persons as long as they remit a $6 fee together with a copy of the application form.

Information Please

Decision comes with two disks in a protective plastic package and a strip of labels for identifying user-created backup and data disks. The distinctive blue labels should help the user keep track of the *Decision* disks.

Hard-copy documentation consists of a single sheet of paper, slightly larger than a 5¼-inch floppy disk, which contains minimal instructions on how to get *Decision* running. Once properly booted, the program offers a selection of ten screens of additional information, but only four of these directly or indirectly assist in software operation. The rest relate to licensing, customer support, and so forth.

Decision deserves a gold star for the information screen (Figure 5) that provides the mathematical formulas used in the decision-making process. This allows the user to decide if the program's decision-making process is credible.

Another gold-star feature is *Decision*'s novel use of its write-protect tab. The metallic gold tab reads: Guaranteed Bug-Free, Once-Begun Computations. *Decision's* full warranty states: "This OBC program is guaranteed to be bug-free. Should a bug ever appear, send a copy of the program, on a good diskette, to OBC. We'll debug it and send it back to you."

Despite *Decision*'s noteworthy features and impressive warranty, its documentation is a bit thin, even for a $20 program. Should OBC decide to update the program beyond the version 1.0 tested, the documentation could use extensive work.

One Manual Fits All

Decision-Analyst also comes on two disks and includes an 8½-by-11-inch size loose-leaf notebook. The documentation is printed with brown ink on buff paper and is indexed by brown, plastic-coated divider tabs that make up a fairly easy-to-read package.

Decision-Analyst was originally written for a CP/M environment. Rather than produce a new manual for DOS users, the company issued revision pages and provided one manual for all users, regardless of system. A package that sells for $139 ought to contain an assembled manual that is written for the specific operating system.

The all-in-one manual approach can

```
 Press the <ESC  key when you have completed your response to this question
*** DECISION-ANALYST SECT 1. • PROBLEM DEFINITION •  FOR TEST1  12/11/83 ***

  WHY NOT DO ABSOLUTELY NOTHING ?


CHAR: G=Del ^V=Insert ^S=Left  D=Right WORD:^A=Left ^F=Right ^T=Del ^Q=Quit
LINE: Y=Del ^N=Insert  X=Down  E=Up  Z=Zap ^W/WW=B/EOLne PAGE:^R=Up ^C=Down
```

Figure 3: Decision-Analyst *uses* WordStar-like *editing commands.*

```
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        Your license and the copyright laws
    allow you to copy DECISION for back-up
    only. However, OBC will permit you to
    make copies for other persons (or to use
    in other machines) if you remit a $6.00
    per copy registration fee and if the new
    user accepts the terms of the license.


        For your convenience, the next page
    (press '+') contains an application form.
    If you have a printer, you'll be able to
    print a copy by pressing 'Shift-PrtSc'.


        When OBC accepts your application,
    the new user will be entitled to all OBC
    Registered User privileges, including
    Customer Service and the OBC Guarantee.


    Please Press 'Esc' (or '+' or '-') When Done
```

Figure 4: Decision*'s authorized copy agreement.*

lead to a great deal of confusion. I found myself continually rereading paragraphs that were unclear because of the multiple operating systems' references. This could be a near-fatal flaw for a software package intended for use by decision makers in a company, rather than by computer people. Executive Software should gear its documentation to the computer-literacy level of IBM PC users, especially in the chapters that help the new user to get the software running.

Executive Software deserves high marks for customer support. I could not get the supplied disks to run and called Executive Software late on a Saturday night for assistance, and someone was there to help me figure it out.

Last Words

While *Decision-Analyst* is clearly the more comprehensive of the two packages, each has a place. For example, I have four word-processing packages and was able to effectively use *Decision* to pick which of the four is best overall. *Decision* helped quantify an analysis that had previously been strictly subjective.

Decision is most useful when you want to get an initial grasp of a problem, or if you are a sole proprietor and don't need the complexity offered by the *Decision-Analyst* package.

Nonetheless, *Decision-Analyst* is the program to use if you need to make a recommendation to your boss, who will analyze both the recommendation and the thought process that went into the decision.

> It is possible that both packages could end up beside the same PC.

It is possible that both packages could end up beside the same PC, with the wise user calling on *Decision* for the quick run-through on a problem, and on *Decision-Analyst* for a more indepth approach.

Naturally, the GIGO (Garbage-In, Garbage-Out) concept applies to both packages. If your assumptions or analysis of the problem are wrong, the decision reached by the programs will be wrong. Of course, you could have discovered you were wrong without using the computer, but at least the computer helped you find out sooner. ■

```
                    FORMULAS used by DECISION

        V = Value        I = Income      C = Choice      W = Weight
        S = Standard     E = Expense     F = Factor      R = Rating

                                n                              n
VALUE   =  100  x  ( d  ( W  x  R  ) ) x ( d  ( W  x  9  ) )
     C             F=1     F     CF          F=1     F

OBC suggests that VALUE differences of less than 5% be discounted.

          V*I RATIO  =  ( V  x  I  )  x  ( 100  x  I  )
                        C     C     C                S

          V/E RATIO  =  ( V  x  E  )  x  ( 100  x  E  )
                        C     C     C                S

RATIO = 1.00 means adjusted V is equal to that of the "perfect" alternative.

                Please Press 'Esc' [or '+' or '-'] When Done
```

Figure 5: *One of* Decision*'s ten information screens that detail the mathematical formulas used by the program.*

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CIRCLE 208 ON READER SERVICE CARD

Assembly Language: The Nature of DOS

Assembly language offers access to DOS routines that interface directly with peripheral hardware, reducing the length of coding for input/output.

In this issue, PC Magazine *offers the second excerpt from Robert Lafore's* Assembly Language Primer for the IBM PC, *to be published by The New American Library under the Plume/Waite imprint,* *copyright 1984 Waite Group, Inc., San Rafael, California. All rights reserved.* *The previous installment included a condensed version of the introduction and Chapter 1 and the whole of Chapter 2 (see "Assembly Language: More Basic Than BASIC,"* PC, *Volume 3 Number 3). This excerpt covers Chapter 4.*

In the IBM PC, as in most modern computers, there is an intimate connection between the assembly language programs that run in the computer and DOS—the disk operating system. We're going to talk about DOS, what it does, and how it relates to assembly language. We'll also write some programs that will extend your understanding of this relationship and at the same time teach you more about assembly language.

You're probably already aware of many of the user-level functions of DOS on your PC. DOS prints the A> prompt, and it's DOS that carries out the commands you type in, like DIR and COPY. Also, when you type a program name like ASM or BASICA, it's DOS that finds the program, loads it into memory, and then waits there to resume control when your program is finished.

So one of the primary purposes of DOS is to manage other programs by keeping them on the disk in such a way that they can be called by name, loaded into memory, and executed and by providing functions to permit you to list, copy, and erase these programs or data files.

These "file management" operations are an essential part of DOS, but they are not the whole story. Beneath the file management part of DOS is another, more sophisticated level, which can only be reached through assembly language. What is this deeper level of DOS, and what does it do?

THE HISTORICAL VIEW

The earliest operating systems performed only the file management functions and provided no further interaction with or assistance to other programs using the system, once they were loaded. Thus, if you wanted to write an assembly language program to, say, put a character on the video screen, you had to figure out exactly how the video circuitry worked and then go

through a complex series of instructions to tell this circuitry where to put the character. Similarly, if you wanted to write a file to the disk, you had to understand the most minute details of the disk operation, such as where every byte is located on the disk, how fast the disk is spinning, and how long it takes the stepping motor to reach different tracks. As you can imagine, resulting programs were very long and complex.

These early operating systems had another disadvantage. If you physically changed your video terminal, your disk drive, or some other device, then you had to rewrite all the programs that used the old devices, since the instructions in your program that worked for one device would not work for another, even if it were only slightly different. Worst of all, your programs would only run on those computers that were exactly the same as yours: same video terminal, same disk drives, same everything. It was impossible to transport a program from one brand of computer to another.

DOS TO THE RESCUE

Then someone had a very clever insight: The routines to access the peripheral devices—the video terminal, the disk drives, and so on—are in the disk operating system because DOS needs to interact with these peripherals. Then the obvious question was, Why not make these routines accessible to other programs? That way, if you want to, say, write a character to the video screen, you wouldn't have to know anything about the video circuitry; all you would need to know is the entry point of the DOS video routine and how to tell it what character to print. Then you could let the DOS routine worry about all the tedious hardware-dependent details.

Does this remind you of anything? In the previous installment ("Assembly Language: More Basic Than BASIC," *PC*, Volume 3 Number 3), we wrote a program that uses routines in DOS. The happy-face program that we created uses the Display Output function call to print characters on the screen. This function call requires only three instructions:

```
MOV DL,1    (Put ASCII character
             in DL register.)
MOV AH,2    (Put DOS function number
             in AH register.)
INT 21      (Interrupt 21 call to DOS.)
```

Putting a character on the screen would require dozens of assembly language instructions if we had to write the complete routine ourselves. With the old-fashioned kind of operating system, we would need to worry about such topics as what mode the display is in, what the horizontal retrace is doing, whether the character is a linefeed (if so, we'd need to move the cursor down a line), whether we are on the bottom line (if so, we might need to scroll the screen up), and so on. But by simply calling a routine in DOS, we change our task from an extremely complex one requiring a detailed understanding of the computer's hardware, to a comparatively simple one involving only a few facts about the operating system and a mere three instructions.

A program to make a "beep" sound on the speaker provides a small example of the difficulties involved in writing our own routines to access a peripheral. In this routine we have to figure out all sorts of details, such as how long a delay loop to make to produce a given pitch. The resulting program is seven instructions long. If there were a DOS function call to perform this function (which there isn't), it would require no detailed understanding of how the speaker works and could get by with only two instructions:

```
MOV AH,99   (Hypothetical number of
             BEEP function.)
INT 21      (Call DOS.)
```

Of course, beeping the speaker is one of the simplest I/O jobs we can perform. The advantages to be gained by using DOS routines are much greater for other peripherals, such as the keyboard and disk drive, as we'll see in the next section.

PROGRAM TRANSPORTABILITY

Besides the convenience of being able to write shorter programs and not needing detailed knowledge of how to program peripherals, there is another big advantage of letting DOS do our input/output: Our program will work even if we replace some of the peripherals with completely different models from different manufacturers.

In fact, our program will even work on an entirely different computer, provided it uses the MS-DOS operating system. Since MS-DOS is very similar to PC-DOS, you can take your happy-face program and run it on any of the so-called IBM-compatible computers that use MS-DOS. The DOS function calls will have the same numbers and be accessed in the same way on any computer using MS-DOS, so your program will operate just as before. On a small program like happy face, this is hardly an earth-shaking issue, but if you have invested thousands of man-hours in a sophisticated accounting or word processing program, it's nice to know that it can be used on a variety of different computers, with little additional programming investment. It's also nice to know that what you learn here is applicable to other computers besides the IBM.

Assembly Language Primer for the IBM PC
Robert Lafore
(The New American Library, Inc., New York, forthcoming) softcover; Price to be announced

CIRCLE 713 ON READER SERVICE CARD

Of course, something has to change when you try to run the same program on a computer with different peripherals or on a different make of computer. What changes are the input/output routines, buried somewhere in DOS, that actually communicate directly with the physical device. Thus, if you get a different kind of disk drive or video terminal or want to use the operating system on a different computer altogether, then you need to change your operating system accordingly. Actually, only part of DOS needs to be changed when I/O routines are changed, the part called IBMBIOS.

We're going to learn more about IBMBIOS and the other parts of DOS in a moment. First, however, let's explore another example of a DOS function call, so you can begin to see the variety of things these calls can do for your programs.

THE KEYBOARD INPUT FUNCTION CALL

You might think it would be a comparatively simple task to read a character from the keyboard into your program. Actually, it is, provided you use DOS's Keyboard Input function

```
;*****************************************************************
; KEYBOARD INPUT Function Call                  Number 01h (1d)  :
;                                                                :
; Enter  with  Reg AH = 1                                        :
;                                                                :
; Execute      INT 21                                            :
;                                                                :
; Return with  keyboard character in Reg AL                      :
;                                                                :
; Comments     ctrl-break causes exit from function              :
;*****************************************************************
```

call. If you wanted to write the code to do it yourself, you would need 10 pages of code! How do we know this? Because that's how much code IBM used in the ROM routine built into the PC, as you can see by looking at page A-23 of Appendix A in the IBM *Technical Reference* manual.

What does all this ROM code do? Well, for example, it has to figure out if the Alt or Shift or Ctrl key is pressed, and what it means when they are combined with other keys. It has to know what to do if the key sequence Ctrl-Break or Alt-Ctrl-Del is pressed. It has to store normal key entries in a buffer (an area of memory), so that if your program is busy doing something else while you are typing, no keystrokes will be lost. If this buffer gets full, the routine has to sound the beeper to let you know. And so on. Aren't you glad you don't have to figure all this out each time you want to read a character from the keyboard?

Fortunately, there are routines built into ROM to help with input/output, and DOS makes use of these routines to simplify assembly language programming.

Here's a short program that makes use of the Keyboard Input function. Load the DEBUG program and type the statements below.

```
A>debug
-a100
08F1:0100 mov ah,1  \
08F1:0102 int 21     :--enter these instructions
08F1:0104 int 20    /
08F1:0106           <---press ENTER to leave "A" command
```

This program is even shorter than the happy-face one! To make sure it's accurate, "unassemble" it with the U command:

```
-u100,105
08F1:0100 B401   MOV  AH,01
08F1:0102 CD21   INT  21
08F1:0104 CD20   INT  20
```

Now, to execute this program, you type G. If nothing seems to be happening and the computer is just sitting there, it's no problem. Just press any key, Z for example.

```
-g
z
Program terminated normally
-
```

The computer comes back to life, and you're in DEBUG again. What was that all about? Nothing mysterious. When you started the program, the first instruction put a 1 in the AH register to tell DOS that we wanted to execute the Keyboard Input function. Then we did an INT 21 instruction to call DOS, which took us straight to the routine to read a character from the keyboard. The function waits until something is typed before it lets the program go on, so until we hit a key the program sits there, looping endlessly in the DOS routine.

Once we strike a key, the function terminates, and the next instruction in our program, INT 20, is executed, terminating the program, and returning us to DEBUG. The ASCII value of the keyboarded character is also returned in the AL register, although this short program does not make use of this fact.

```
-g                  <---run the program
z                   <---type a normal character
Program terminated normally
-g                  <---run the program again
^C                  <---type CTRL-BREAK

AX=0100  BX=0000  CX=0000  DX=0000  SP=FFEE  BP=0000  SI=0000  DI=0000
DS=0BF1  ES=0BF1  SS=0BF1  CS=0BF1  IP=0104   NV UP DI PL NZ NA PO NC
0BF1:0104 CD20          INT     20
```

Figure 1: *This display of the registers shows IP=0104.*

POTENTIAL TROUBLE

One keyboard sequence will cause things to act a little differently if you type it in this program: the Ctrl-Break key combination (which is the same as Ctrl-C). Let's see what happens (Figure 1).

You get a print-out of all the registers, the one that you get by typing DEBUG's R command. And now, try typing G to run the program again:

```
-g  (Run it.)
    (It doesn't wait for you
    to type something.)
Program terminated normally
-g  (Try it again.)
    (Same result.)
Program terminated normally
```

Something's gone wrong with the program: It is no longer waiting for input from the keyboard when we type G to run it, but instead says "Program terminated normally" immediately. Why is that?

Look closely at the register display in Figure 1. We will learn about a new part of this display to understand where our program went awry. In the center of the middle row appears the expression "IP=0104." To understand its significance, you need to know that the 8088 keeps track of where it is in a program by keeping the address of the instruction currently being executed in the instruction pointer or IP register. The IP register is a 16-bit register something like AX, BX, and so on, except that it is used *only* to hold the address of the current instruction. Each time an instruction is executed, the 8088 updates the IP register to point to the next instruction.

Thus, at the beginning of our program, IP contains 100, since that's where all programs are supposed to start in DEBUG. In fact, DEBUG puts this value into IP when it's first loaded, as you can see by loading DEBUG and immediately typing R. After we execute the first instruction in our program, the IP contains 102, since that's the address of the next instruction. And finally, for the last instruction, it contains 106. When the program terminates with an INT 20 instruction, DEBUG automatically sets the IP register back to 100, so that it's ready to start the program again.

The reason our program doesn't work the way it should is this: When you hit Ctrl-Break, DEBUG terminates the program right in the middle, just before the program has a chance to execute the INT 20 instruction. The instruction shown in IP in the register display is the one *about to be executed*. So, when we return to DEBUG from our program, the IP contains 104, not 100 as it should. Since the program has not terminated with an INT 20 instruction, the IP will not be reset to 100. So when you type G, DEBUG will start the program at whatever address is in the IP register. If 104 is in IP, then that's where the program will start. But the only thing at 104 is an INT 20, which will terminate the program and bring us back to DEBUG with a "Program terminated normally" message. The call to the Keyboard Input function will never be executed.

How can you start over at the beginning of the program? It turns out you can modify the contents of the IP register with DEBUG, just as you can the AX register and other general registers. Enter R, followed by IP.

```
-rip      (You type this to see
          the IP register.)
IP 0104   (Contents of IP.)
:100      (Type this to change it to 100.)
-g        (Now try the program again.)
z         (It waits for you
          to type a character!)
Program terminated normally
```

So we've fixed it! The moral is that it's only when your program starts at 100 and terminates itself with an INT 20 that DEBUG will automatically reset the IP to 100. If you start the program somewhere else, or terminate it in the middle, then you can't be sure what may be left in the IP register. To avoid problems, get in the habit of checking the IP by typing RIP and setting it back to 100 if necessary, before you type G to run a program.

TYPING IN A SENTENCE

Suppose we wanted to use the Keyboard Input function to type in something longer than a single character. As you might guess, we can simply change the INT 20 to jump back to the beginning of the program: JMP 100. Here's what you type in:

```
-a100
08F1:0100 MOV AH,1
08F1:0102 INT 21
08F1:0104 JMP 100
08F1:0106
```

And here it is disassembled with U:

```
-u100,105
08F1:0100 8401   MOV   AH,01
08F1:0102 CD21   INT   21
08F1:0104 EBFA   JMP   0100
```

Now when we run the program, we can type in a whole sentence. While you're typing, you can experiment with some of the editing features built into this system call. For instance, if you make a mistake, you can backspace. If you type Ctrl-J (the J key pressed while the Ctrl key is held down), you'll get a linefeed. And if you hit Enter, the cursor will return to the start of the line, although you will still be in the function. But if

```
-g
Now is the time for all good men to come to the aid of their country
^C

AX=0100  BX=0000  CX=0000  DX=0000  SP=FFEE  BP=0000  SI=0000  DI=0000
DS=08F1  ES=08F1  SS=08F1  CS=08F1  IP=0104   NV UP DI PL NZ NA PO NC
08F1:0104 EBFA          JMP     0100
```

Figure 2: *Escaping from the program with Ctrl-Break.*

hitting Enter does this, how do we escape from our program? Try Ctrl-Break—without further ado you'll be back in DEBUG.

Actually it's not quite as clean as shown in Figure 2, because the ^C (Ctrl-Break) prints over the first part of the phrase you typed in:

```
-g
^Cw is the time for all good men to come to
the aid of their country.
```

Notice how the registers have all been printed out in Figure 2, as they were when we typed Ctrl-C in the single-key program in Figure 1. Again, the IP contains 104. But this time it doesn't matter if we set it back to 100 or not: Since the program consists of an endless loop, we can get into it anywhere without changing its operation.

You may be concerned that the programs we've used to demonstrate these functions so far don't seem to do anything very useful. Don't worry. We'll combine the function calls we've learned into larger programs that will actually perform useful services and amaze your friends. Now, however, let's go back and talk about the various parts of DOS and where these function calls fit into the overall DOS organization.

THE PARTS OF DOS

Earlier we mentioned ROM and IBMBIOS and said that they were parts of the disk operating system. Let's pause to describe the major parts of DOS, what they do, and where they fit in the computer's memory. Be aware, however, that you really don't need to know a great deal about the internal workings of DOS to write programs in assembly language. So don't worry if some of the details of its operation seem a little vague at this point. You'll learn more about the operating system as we go along.

DOS is divided into four major parts: ROM, IBMBIOS, IBMDOS, and COMMAND. Figure 3 indicates how they are loaded into memory. Notice that the lowest addresses are shown at the top of the diagram. Though this may seem backwards, it's the way program listings are written, and it's the way IBM does it, so for consistency we're going to follow this format too.

To understand the roles played by the various parts of DOS, it's helpful to think of the entire operating system as some sort of large industrial corporation—we could call it DOS Incorporated. The different parts of the system then correspond (very roughly) to the different management levels in the corporation (see Figure 4).

The Workers: ROM

ROM, standing for read-only memory, corresponds to the blue-collar workers down on the factory floor who get the actual work done. In DOS this work might be sending characters to the display screen, reading information from the disk drive and the keyboard, and so forth. By actually getting the work done we mean that the routines in ROM send instructions to peripheral devices such as the keyboard and disk drive that actually cause changes in the outside world. This is the point where software "interfaces" (connects with) hardware.

The "products" that the ROM routines generate are concerned with moving information from hardware to software and vice versa: reading a character from the screen into memory, sending data from memory to the disk, and other such operations. In other words, ROM contains most of the actual input/output routines that communicate with the peripheral devices connected to the PC. *(continued)*

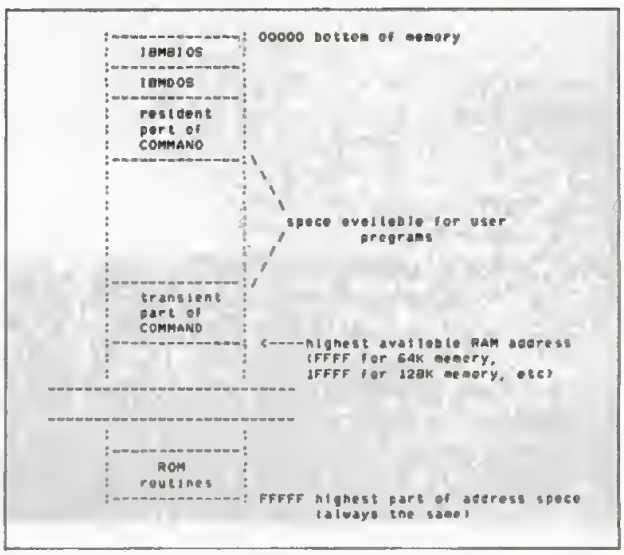


Figure 3: *The four major parts of DOS.*

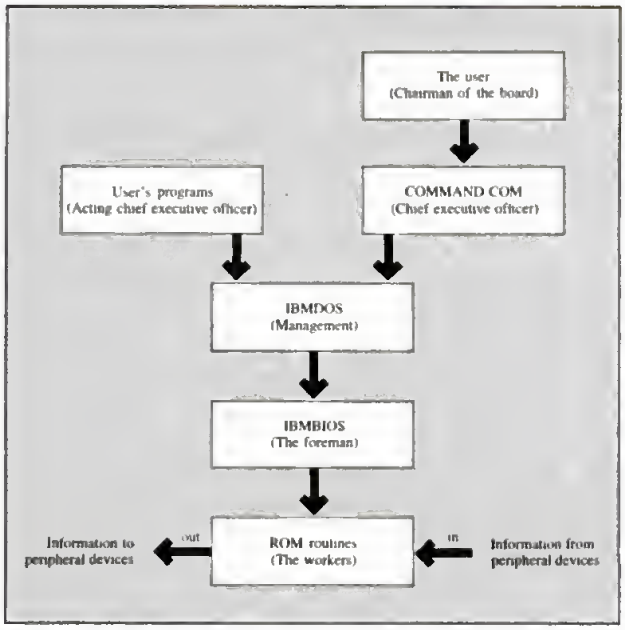


Figure 4: *The operating system represented as a corporate chain of command.*

ROM is an actual physical part of the computer, like RAM (random access memory), where you store your program—except that the programs in ROM are installed by IBM at the factory and can't be changed. (Also they don't vanish when you turn off the computer, the way programs stored in RAM do.) Since ROM is part of the physical computer, it is documented in IBM's *Technical Reference* manual, which describes the physical characteristics of the machine, rather than in the *Disk Operating System* manual.

You might not think of ROM as being part of DOS, since it exists even in cassette-based IBM PCs that don't have disk drives. But ROM is not limited to supporting DOS. In a cassette-based IBM PC that, obviously, does not use DOS, ROM provides the computer with BASIC. In a PC capable of loading DOS, ROM contains routines to access the disks and other peripherals. When DOS is loaded from the diskette, the routines in ROM become an integral part of the operating system. (The rest of DOS comes on the DOS diskette and is loaded from the diskette when you initialize your system, either by turning it on, if it's off, or by hitting Ctrl-Alt-Del.)

The Foreman: IBMBIOS

IBMBIOS supervises the activities of the ROM routines. If IBMDOS or another program wants to use a routine in ROM, the request is "passed through" IBMBIOS. That is, the request goes to IBMBIOS, which decides what to do with it before passing it on to the appropriate ROM routine. This has several advantages. If IBM discovers a mistake in ROM, or if it wants to modify ROM for some reason, it can't actually change the ROM in those computers that have already been sold (since the ROM is a permanent part of the computer), but it can change the DOS diskette, which contains IBMBIOS, so that it incorporates the changes. This is like a human foreman who has learned so well what mistakes his employees are likely to make that he can successfully compensate for them in the finished product.

Thus by issuing a new operating system with the revised IBMBIOS, IBM can in effect change the input/output routines in ROM, even though ROM itself is unchanged. (Modifications of this sort lead to revisions of the operating system, such as the change from DOS 1.0 to DOS 1.1, and so on.) Also, various errors that can occur when an I/O routine is in use can be dealt with more flexibly if the routine is not a permanent part of ROM.

Management: IBMDOS

IBMDOS concerns itself with more general, less detailed problems than do ROM and IBMBIOS. You can think of it as the management part of DOS, having a larger perspective than the workers or the foreman. For instance, RAM and IBMBIOS know how to write a particular *sector* (a small amount of disk information) to the disk, but IBMDOS knows what entire *file* is to be written to the disk and keeps track of what sectors have been written so far and where they are on the disk.

IBMDOS also contains the "entry points" for the DOS function calls, like the Display Output and Keyboard Input functions. (Entry points are simply addresses where these routines begin in memory.) It's this part of DOS that our assembly language programs will be communicating with when they need to perform any input or output operations. The actual input/output routines may be in ROM, but your program must go through IBMDOS to use them, just as in a corporation we wouldn't place an order for 1,000 widgets with the workers in the assembly line; we'd talk with some management-level people on a higher floor.

Chief Executive Officer: COMMAND.COM

COMMAND.COM is responsible for controlling the overall activities of the operating system. It's the part of DOS that prints the A> prompt and then figures out what to do with what you type in—the intelligent part, you might say, of the operating system. The other parts merely do what they're told, either by COMMAND.COM or by another assembly language program.

COMMAND.COM actually comes in two parts: a *resident* portion, which lies just above IBMDOS in low memory, and a *transient* portion that sits all the way at the top of memory—up to FFFF if you have 64K, up to 1FFFF if you have 128K, and so on. (Notice the difference between the memory you actually

have, which might be, say, 128K, and the entire addressable memory space in the computer, which is one megabyte or 1,000K, with a high address of FFFFF.) "Resident" means that this part of COMMAND.COM remains in memory at all times. It contains basic control functions and error-handling routines, while the transient portion communicates with users via the A> prompt and contains the internal DOS commands like DIR, TYPE, and COPY.

The transient part of COMMAND.COM can actually be written over by user programs if they need a lot of memory space. It is then loaded back into memory from the diskette by the resident portion when the user program is finished.

Acting Chief Executive Officers

When we write an applications program in assembly language (or in a higher-level language like Pascal, which is then compiled into assembly language) and then execute it, the program takes over temporarily from the COMMAND.COM program and assumes command of the computer itself. It then has access to all the facilities provided by IBMDOS, IBMBIOS, and ROM, just as COMMAND.COM does when it's in charge. It can use these resources for its own purposes, and COMMAND.COM can only regain control when the program is over, as when it executes the INT 20 interrupt.

Chairman of the Board

And who, you might ask, tells COMMAND.COM what to do? Why, you do, of course—whenever you type a command following the A> prompt. Isn't it this opportunity to exercise corporate power that convinced you to buy a computer in the first place?

DOS FUNCTION CALLS

We learned above that the DOS function calls are input/output routines located in the ROM and in the IBMBIOS portion of DOS. They are accessed by making interrupt calls of the form INT 21 to the IBMDOS part of the operating system, which then passes our request on to the appropriate routine in IBMBIOS or ROM. The particular function to be used is selected, as we've seen, by placing a particular number in the AH register before making the INT 21 call to DOS.

In the first installment, we used the Display Output DOS function to write a happy face and other characters on the screen, and in this installment we used the Keyboard Input DOS function to get a character from the keyboard. What other DOS function calls are there?

The most complete description of these functions is given in Appendix D of IBM's *Disk Operating System* manual, which comes with your copy of DOS. In DOS version 1.1 the functions start with 0 and go up to number 2Eh, for a total of 41 functions. (2Eh is more than 41d because not all the available numbers were assigned.) DOS version 2.0 uses 74 functions, and there is no reason why new versions of DOS will not contain even more. It might be educational for you to look through this appendix, just to get a rough idea of the kinds of things these calls do. Many of the descriptions will be mysterious to you at this point, but in time, you will be reading Appendix D for relaxation, like the Sunday comics.

Since there are so many function calls, we are not going to provide detailed descriptions of them all. Instead, we will concentrate on the most commonly used ones and those that most easily demonstrate how particular parts of the operating system work. Once you know these, you should be able to figure out how the others work, since there are many similarities.

DOS functions can be divided roughly into two categories: those that deal with the disk and those that deal with other peripherals, such as the video screen, keyboard, and printer. We will cover several of the nondisk functions, which are generally simpler.

The Print String Function Call

Let's start off by learning a new DOS function: The Print

```
PRINT STRING function Call                    Number 09h 19d)

Enter  with  Reg AH = 9
                  DS DX = address of start of string

Execute      INT 21

Comments     string must terminate with "$" (dollar-sign)
```

String function call prints a string of characters. We already know how to print a single character on the screen, using the Display Output function call. That's good as far as it goes, but many times in a program we'd like to display a whole string of characters at once. Print String lets us do just that.

Here's how it works. Before you can use this function you need to put the string—consisting of the actual characters you're going to print—somewhere in memory. The string consists of ASCII characters, and it *must* end with a dollar sign ($). The dollar sign is the only way the function knows when it's come to the end of the string, so it's important that you not forget it.

To use the Print String function, you first put the address of the string in the DX register. (Don't worry about the designation "DS:DX" in the box above. The DS is a segment register, which you don't need to worry about for the time being.) Next,

```
A>debug
-a100
08F1:0100 mov dx,109
08F1:0103 mov ah,9
08F1:0105 int 21
08F1:0107 int 20
08F1:0109 db 'Good Morning, Robert!$'
08F1:011F
```

Figure 5: *A program to print "Good Morning, Robert!"*

you put the function number 9 in the AH register, and finally you call DOS with an INT 21. Let's write a program that makes use of this function to print a string.

The DB Pseudo-Op

All the instructions look pretty familiar in the program in Figure 5, except for this one:

```
08F1:0109 DB 'Good Morning, Robert!$'
```

This doesn't look like an ordinary assembly language instruction, and it's not. In fact, it's a very strange sort of animal. Instead of being an instruction that tells the 8088 microprocessor to do something, it's an instruction that tells DEBUG (or the assembler program) what to do. In this case, it tells DEBUG to put into memory all the bytes represented by the characters between the single quotation marks. Thus G is translated into its ASCII code 47h, o into 6Fh, and so on. These values are then placed in memory. Note that DB itself is not placed in memory, since it is not really an instruction and is not going to be executed by the 8088. Once it has told DEBUG to put the characters in memory, its job is done. It's called a "pseudo-op" because it's not really an operation code or instruction. It goes in the same place in the program as regular instructions, but it has a different purpose.

DB, which stands for "define byte," is very useful for putting ASCII codes into memory, since we don't have to look up the code for each value and then type it in with the E command. (Of course, if you don't have DOS version 2, you'll have to use the E command anyway, but you won't need to look up the values, since they will show when we disassemble the program with U.)

You can also use DB to put numeric values into memory, either by themselves or with ASCII characters. We'll show an example of this in the next section.

Don't forget the theoretical difference between regular assembler instructions like MOV and JMP (which are sometimes called "operation codes" or "op-codes") and pseudo-ops like DB. Instructions tell the *8088 microprocessor* what to do at the time the program is executed. Pseudo-ops, on the other hand, tell the *assembler program* (in this case DEBUG), what to do when the program is being assembled.

Here's the program unassembled (or disassembled, which is the same thing) with the U command:

```
-u100,108
0905:0100 BA0901    MOV   DX,0109
0905:0103 B409      MOV   AH,09
0905:0105 CD21      INT   21
0905:0107 CD20      INT   20
```

U does not help us discover what bytes the DB pseudo-op has placed in memory, since these bytes are not program instructions. Instead, we'll use D, which provides not only the hex values of these bytes but the ASCII characters they represent. See Figure 6.

The program occupies the first 9 bytes of the top row. Then our string of characters starts and continues all the way to the byte at 11E. Notice that the last byte is a dollar sign (24h), as required by the Print String function.

Save the program to your disk:

```
-nwakeup.com
-rbx
BX 0000
:
-rcx
CX 001F
:
-w
Writing 001F bytes
```

Now, finally, run the program! It should work just fine.

```
-g
Good Morning, Robert!
Program terminated normally
```

You can also execute the program directly from DOS. Turn on the computer and type:

```
A>wakeup
Good Morning, Robert!
```

It's kind of nice: a personal greeting from the cold impersonal machine. Of course, you can customize this program with your own name simply by changing the phrase between the quotes in the DB pseudo-op. Try it.

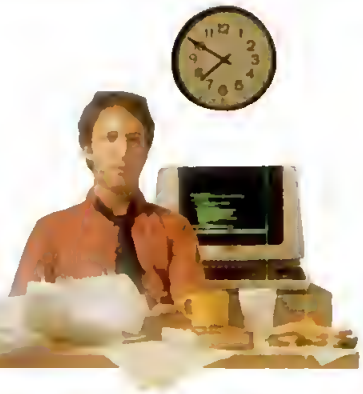
(continued)

```
-d100,11f
08F1:0100  BA 09 01 B4 09 CD 21 CD-20 47 6F 6F 64 20 4D 6F   :..4.M'M Good Mo
08F1:0110  72 6E 69 6E 67 2C 20 52-6F 62 65 72 74 21 24 3A   rning, Robert!$.
                                                    :
                                                dollar sign
```

Figure 6: *The hex values and ASCII characters of the bytes placed in memory by the DB pseudo-op instruction.*

See COBOL.

Dick is a COBOL programmer. Dick is bored. Harried. Dick struggles with trace and debugging routines. Nonexistent documentation. Mainframe logjams. So Dick is four months behind schedule. And users are upset about turnaround times. They yell and make Dick upset. They make Dick's boss upset. Nobody is very happy.



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CIRCLE 133 ON READER SERVICE CARD

Buffered Keyboard Input Function Call

Now that you know how to print out a string of characters, how about reading a string in from the keyboard? The Buffered Keyboard Input function call is a DOS function that will do just that.

```
;*****************************************************************
; BUFFERED KEYBOARD INPUT Function Call          Number 0Ah     ;
;                                                               ;
; Enter  with  Reg AH = 0Ah                                     ;
;              Reg DS DX = address of buffer                    ;
;                                                               ;
; Execute      INT 21                                           ;
;                                                               ;
; Return with  keyboard characters in buffer                    ;
;                                                               ;
; Comments     First byte of buffer = maximum character count   ;
;              Second byte = actual number of characters typed  ;
;*****************************************************************
```

There is something new here—the expression:

```
Reg DS:DX address of buffer
```

This expression means that the function needs both the segment address and the offset address of the string and that the segment address is to be placed in the DS register, the offset address in the DX register. Actually you don't need to know about the DS register at this point. DEBUG (or DOS) takes care of making sure the correct value is in this register, so for the time being you can ignore it.

Here's a program that makes use of the Buffered Keyboard Input DOS function.

```
A>debug
-a100
08F1:0100 MOV DX,109
08F1:0103 MOV AH,A
08F1:0105 INT 21
08F1:0107 INT 20
08F1:0109 DB 20
08F1:010A
```

What's going on here? The idea is that the characters you type on the keyboard will be stored in a buffer (a buffer is just a sequence of memory locations). In the program above, the buffer is defined in the program line:

```
08F1:0109 DB 20
```

This statement tells DEBUG to set aside 20h (32d) unused locations in memory. Your program tells the function where this buffer is by placing its address in the DX register with the MOV DX,109 instruction. The function number is Ah, so that's placed in the AH register, and then you call DOS with an INT 21 command, as usual.

The key to using this function is to understand how the buffer is organized. Figure 7 is a diagram of the buffer.

The first byte of the buffer holds a number representing the maximum number of characters the function will accept from the keyboard—in this case 20h, which is 32d. If you try to type more than this maximum, the beep sounds and the cursor refuses to move any further left (as we will see shortly). This number can never be larger than 255d, since it only occupies one byte.

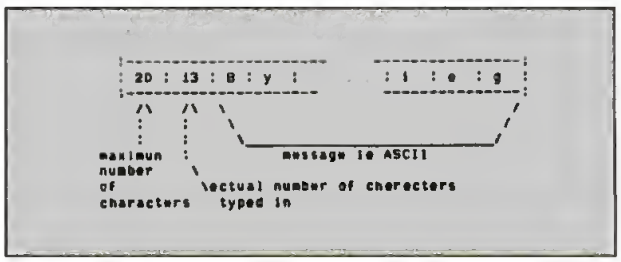

Figure 7: *A diagram of how the buffer is organized.*

The second slot in the buffer is filled in by the function (not by your program) after you type in the message and press Enter. The number the function inserts is the actual number of characters you typed in. This is the only way your program can figure out how many characters are in your message.

The message itself goes in the bytes following these two 1-byte numbers.

Let's try out our program and see what happens. If you want, save it to disk first:

```
-nbuffin.com
-rbx
BX 0000
:
-rcx
CX 0000
:a
-w
Writing 000A bytes
```

Let's examine it with U to make sure it looks right:

```
-u100,108
0905:0100 BA0901    MOV   DX,0109
0905:0103 B40A      MOV   AH,0A
0905:0105 CD21      INT   21
0905:0107 CD20      INT   20
```

To check that our buffer has been initialized properly, we can dump just the single byte at 109 by typing:

```
-d109,109
0905:0109    20
```

Looks fine. The single byte at 109 is, of course, the maximum number of bytes the buffer can hold: 20h.

Let's run the program with G and then type something in. See Figure 8.

Actually, we could only type 31d characters before the beeper sounded, not 32d, the number we put in the first byte of

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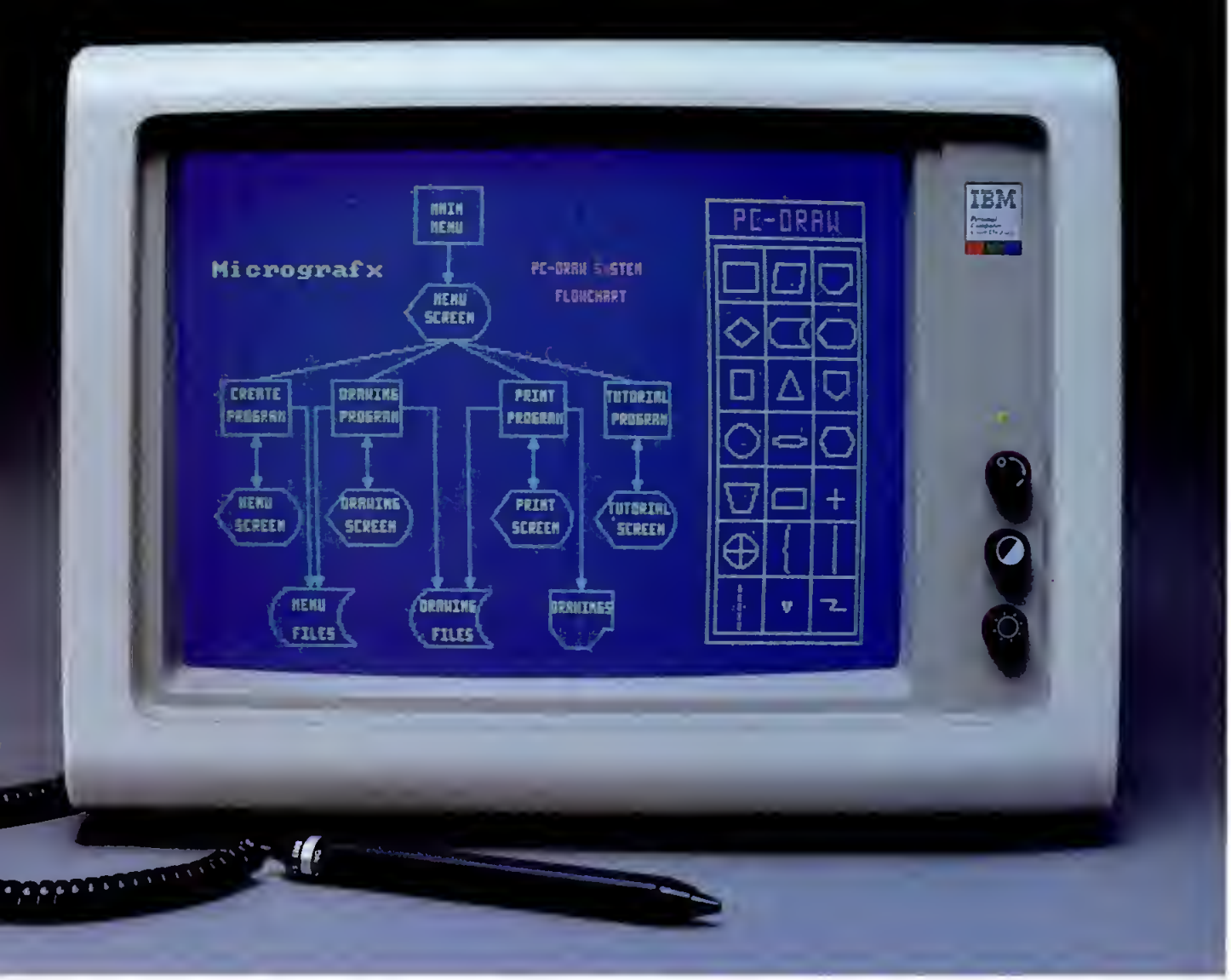

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```
-g
By brooks too broad for leaping
Program terminated normally     /\
                                 :
                                At this point we couldn't type
                                any more characters
```

Figure 8: *The beeper sounds and the cursor stops to save room for the carriage return.*

the buffer to specify the maximum number of characters (32d = 20h). We are limited to 31d because the Enter character itself (often called a "return" or "carriage return," which has the value ODh) is always placed at the end of the message, and room needs to be saved for it. Look at the buffer with DEBUG (see Figure 9).

If you run the program again but hit Enter before you've filled up the buffer, then there will be a smaller count in the second byte of the buffer, as shown in Figure 10.

Notice how the remnant of the old message is left in the buffer. We know that this is junk because the character count is only 13h or 19d, the number of characters in the phrase *Question authority!*

The MIRROR Program

Putting together the last two DOS functions we've learned, let's make a program that takes a sentence you type in and echoes or "mirrors" it back onto the screen.

Type in the program in Figure 11 (don't type in the comments on the right, of course). Then save it to disk in the usual way as MIRROR.COM. Figure 12 shows what it looks like with the U command. Figure 13 shows the buffer, which starts at 116.

```
-a100
0905:0100 mov dx,119 \
0905:0103 mov ah,0     ;--Buffered Keyboard Input
0905:0105 int 21       /
0905:0107 mov dl,0     \
0905:0109 mov ah,2     ;--Display Output (linefeed)
0905:010B int 21       /
0905:010D mov dx,118 \
0905:0110 mov ah,9     ;--Print String
0905:0112 int 21       /
0905:0114 int 20       <---return to DEBUG or DOS
0905:0116 db 30        <---maximum characters
0905:0117
```

Figure 11: *The MIRROR program.*

```
-u100,115
0905:0100 BA1601          MOV     DX,0116
0905:0103 B40A            MOV     AH,0A
0905:0105 CD21            INT     21
0905:0107 B20A            MOV     DL,0A
0905:0109 B402            MOV     AH,02
0905:010B CD21            INT     21
0905:010D BA1801          MOV     DX,0118
0905:0110 B409            MOV     AH,09
0905:0112 CD21            INT     21
0905:0114 CD20            INT     20
```

Figure 12: *MIRROR.COM disassembled with the U command.*

Let's see what the program does. As you can see, it's divided into three major parts. The first part gets our input from the keyboard and puts it into the buffer set up at location 116. The message actually goes into the addresses starting at 118; as before, 116 holds the maximum count, and 117 is filled in with the actual number of characters received from the keyboard.

The second part of the program uses the Display Output function to print a linefeed. (The ASCII code for a linefeed is

```
                                                  /-----actual number of
                                                 /       characters typed
                program          maximum number        /
                      :          of characters :      /  /----beginning of
                      :                        :     /  /      message
-d100,12f   /                          \       :    /  /
0905:0100   BA 09 01 B4 0A CD 21 CD-20 20 1F 42 79 20 62 72   :..4.M!M  By br
0905:0110   6F 6F 6B 73 20 74 6F 6F-20 62 72 6F 61 64 20 66   ooks too broad f
0905:0120   6F 72 20 6C 65 61 70 69-6E 67 0D 00 00 00 00 00   or leaping
                                                 \
                                                  \return character
                                                   at end of message
```

Figure 9: *Looking at the buffer with DEBUG.*

```
-g                                              actual number of
Question Authority!                            / characters typed
Program terminated normally                   /
-d100,12f                                    /
0905:0100   BA 09 01 B4 0A CD 21 CD-20 20 13 51 75 65 73 74   :..4.M!M  Quest
0905:0110   69 6F 6E 20 41 75 74 68-6F 72 69 74 79 21 0D 66   ion Authority!.f
0905:0120   6F 72 20 6C 65 61 70 69-6E 67 0D 00 00 00 00 00   or leaping......
```

Figure 10: *The actual number of characters in* Question Authority! *is 13h.*

```
                                                    /-----actual number of
      last part of          maximum                /   characters typed
         program          number of:              /
                             :   characters :     /   /----beginning of
                             :______________:     /   /     message
-d110,14f   /                \   :    /   /
0905:0110   B4 09 CD 21 CD 20 30 00-00 00 00 00 00 00 00 00    4.M!M 0.........
0905:0120   00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00    ................
0905:0130   00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00    ................
0905:0140   00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00    ................
```

Figure 13: *The three major parts of the program are assigned to different buffer locations.*

```
-d110,14f
0905:0110   B4 09 CD 21 CD 20 30 2B-54 6B 65 20 63 75 72 66    4.M!M 0+The curf
0905:0120   65 77 20 74 6F 6C 6C 73-20 74 6B 65 20 6B 6E 65    ew tolls the kne
0905:0130   6C 6C 20 6F 66 20 70 61-72 74 69 6E 67 20 64 61    ll of parting da
0905:0140   79 2C 24 0D 00 00 00 00-00 00 00 00 00 00 00 00    y,$             . .
-q                  \                                          /
                     \                                        /
                      \This is the obligatory dollar-sign ----/
```

Figure 14: *Looking at the buffer with the D command.*

OAh, which we type in as A. This is necessary because the Buffered Keyboard Input function prints a carriage return at the end of the string but not a linefeed, so that the cursor simply goes back to the beginning of the line we typed in. If we started printing here, we would overwrite what we had just typed.

Finally, the third part of the program uses the Print String function to print out the phrase we typed in. As far as this function is concerned, the buffer starts at the place where the first character of the message is, not where the maximum count is, so 118 is the number we put in the DX register.

Another important thing to remember about Print String is that the only way it knows when to stop outputting characters is when it sees the dollar sign ($). It's very important, therefore, to terminate the sentence you type in with a $. Otherwise the function will run amok, printing all the junk it finds in memory and covering the screen with weird symbols. A more sophisticated program could fill in the dollar sign for us, but this simple program is not fail-safe in this regard.

All right, let's try it out. Start the program by typing G and then type something in.

```
-g
The curfew tolls the knell of parting day,◆ <---you type this
The curfew tolls the knell of parting day,  <---program prints
Program terminated normally                        this
-
```

If your screen looks like this, you got a perfect echo. Now you can look at the buffer with D to see what happened (see Figure 14).

One of the important things to notice in this program is the different way the two function calls deal with the buffer. The address passed to Buffered Keyboard Input in the DX register is actually 2 bytes before the start of the string to allow for the maximum-characters number and the characters-typed-in number. The number passed to Print String, however, is at the start of the string itself. Since Print String pays no attention to the characters-typed-in number, a dollar sign ($) must be used to end the string.

WRITING TO THE PRINTER

Let's see if we can learn to use an entirely new piece of peripheral equipment, the printer. We're also going to talk about an important new idea called *indirect addressing*, so even if you don't have a printer you should read this section.

Characters are sent to the printer using the Printer Output function call, which sends *one character at a time* from the DL register, much as the Display Output function does for the video screen. (In fact, if you don't have a printer you can

```
◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
: PRINTER OUTPUT Function Call                  Number 05h (5d)   :
:                                                                 :
: Enter  with  Reg AH = 5                                         :
:              Reg DL = character to be printed                   :
:                                                                 :
: Execute      INT 21                                             :
:                                                                 :
◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
```

rewrite these programs to work with Display Output, so that you can see what they do.) There is no function that sends a string of characters to the printer all at once, as the Print String function does to the video.

The absence of such a function leads to an interesting problem. Suppose we have a string of characters in memory somewhere, such as we did in the previous section when we filled up

```
0905 0100 mov dl,[122]    <---send "h" to printer
0905 0104 mov ah,5
0905 0106 int 21
0905 0108 mov dl,[123]    <---send "i" to printer
0905 010C mov ah,5
0905 010E int 21
0905 0110 mov dl,[124]    <---send carriage return to printer
0905 0114 mov ah,5
0905 0116 int 21
0905 0119 mov dl,[125]    <---send linefeed to printer
0905 011C mov ah,5
0905 011E int 21
0905 0120 int 20          <---return
0905 0122 db 'hi',09,0e   <---ASCII string
0905 0129
```

Figure 15: *A not-so-elegant way to print a string.*

```
-u100,121
0905:0100 8A162201      MOV     DL,[0122]
0905:0104 8405          MOV     AH,05
0905:0106 CD21          INT     21
0905:0108 8A162301      MOV     DL,[0123]
0905:010C 8405          MOV     AH,05
0905:010E CD21          INT     21
0905:0110 8A162401      MOV     DL,[0124]
0905:0114 8405          MOV     AH,05
0905:0116 CD21          INT     21
0905:0118 8A162501      MOV     DL,[0125]
0905:011C 8405          MOV     AH,05
0905:011E CD21          INT     21
0905:0120 CD20          INT     20
```

Figure 16: *PRINTHI.COM disassembled with the U command.*

a buffer in memory with the Buffered Keyboard Input function. And suppose we want to send these characters in the buffer to the printer. How do we get the characters from their memory locations into the DL register so we can send them to the printer?

We're going to show you two different ways to access strings of characters in memory. The first is clumsy but will serve as an introduction to a technique called *indirect addressing*. The second will make use of indirect addressing in a different way to do the job considerably more elegantly.

The Not-So-Elegant Way to Print a String

In the following program we're going to send the word *hi* to the printer. Then, since the printer will not actually print anything unless it has received an entire line (80 characters) or unless it receives a carriage return, we'll send it a carriage return. Finally, to make sure that the next line we print doesn't overprint the first one, we'll send it a linefeed as well. These four characters, *h*, *i*, ODh (the ASCII code for a carriage return) and OAh (the ASCII code for a linefeed), will all be assembled by DEBUG into a buffer in memory.

Type in the program shown in Figure 15. (The square brackets, which you haven't encountered before, are on the two keys to the right of the P key and are lower-case. We'll explain in a moment what they do.) Save the program if you want, as PRINTHI.COM.

```
-rcx
CX 001E
:26
-nprinthi.com
-w
Writing 0026 bytes
```

Use the U command to see that you typed it in accurately (see Figure 16). D permits you to look at the ASCII string (see Figure 17).

Now, run the program, making sure that your printer is turned on and set to on-line:

```
-g    (Nothing printed on screen, but
       printer prints.)
Program terminated normally
```

If all went well, your printer printed the word *hi*. If you run the program a second time, it will print *hi* again on the next line, and so on.

Now we're going to talk about the meaning of the square brackets in the program in Figure 15. Recall that if you have the instruction:

```
MOV DL,122
```

the number 122h will be placed in the DL register. What about the same instruction with brackets around the 122?

```
MOV DL,[122]
```

This instruction takes the contents of memory location 122 and

```
-d120,12f
08F1:0120  6C 46 68 69 0D 0A 87 DA-E8 86 F0 E8 DE FA 0E 00   1Fhi  Zh ph^z
                  :  :  :  :                                  \__/
                  :  :  :  :___linefeed                         :
                  :  :  :                                     ASCII
                  :  :  :______carriage return                values
                  :  :
                  :  :__________"i"
                  :
                  :______________"h"
```

Figure 17: *Using the D command to inspect the ASCII string of PRINTHI.COM.*

```
-a100
0905:0100 mov cx,31          number of characters to print
0905:0103 mov bx,111         address of first character
0905:0106 mov dl,[bx]        put the character in DL
0905:0108 mov ah,5           Printer Output DOS function
0905:010A int 21             call DOS
0905:010C inc bx             increment the pointer
0905:010D loop 106           loop until done
0905:010F int 20             return to DEBUG or DOS
0905:0111 db 'She is most fair, though she be marble-hearted.',0d,0a
0905:0142
```

Figure 18: *A more elegant way to print a string.*

```
-d111,141
0905:0111  53 68 65 20 69 73 20-6D 6F 73 74 20 66 61 69      She is most fai
0905:0120  72 2C 20 74 68 6F 75 67-68 20 73 68 65 20 62 65   r, though she be
0905:0130  20 6D 61 72 62 6C 65 2D-68 65 61 72 74 65 64 2E    marble-hearted
0905:0140  0D 0A
```

Figure 19: *Using the D command to inspect the ASCII string of PSTRING.COM.*

places it in the register DL. The brackets, that is to say, indicate *indirection*.

If you aren't familiar with the concept of indirection, it may take a little getting used to. Indirect addressing means referring to the address of something, rather than to the something itself. Where before we talked about the contents of a register, now we're talking about the contents of the memory location that is in the register.

Look at the dump we made of the ASCII string in locations 122 to 125. The first letter, h, is in location 122. When the instruction:

```
MOV DL,[122]
```

is executed, the *contents* of location 122, which is 68h (the ASCII code for h), will be placed in the DL register. The number 122 itself doesn't go anywhere, but the instruction uses it to figure out where to get the h.

To print the next character we execute the same sequence of instructions, but this time we take the character out of memory location 123. This is the i character. We do the same thing with the carriage return (ODh) and linefeed (OAh), and our message is completed.

You will no doubt have noted how inefficient this program is. It has to execute a completely different instruction every time it wants to load a different character into the DL register. If you're thinking that there must be a better way, you're absolutely right. We've introduced you to the idea of indirect addressing in its simplest form; now let's see how powerful an idea it is when it's used in a slightly different way.

A More Elegant Way to Print a String

Use DEBUG to type into memory the program in Figure 18, which will send a complete string of any length to the printer. In this case the string (courtesy of an anonymous sixteenth-century poet) is in line 111. The U command listing appears below.

```
-u100,10f
0905:0100 893100        MOV     CX,0031
0905:0103 BB1101        MOV     BX,0111
0905:0106 8A17          MOV     DL,[BX]
0905:0108 B405          MOV     AH,05
0905:010A CD21          INT     21
0905:010C 43            INC     BX
0905:010D E2F7          LOOP    0106
0905:010F CD20          INT     20
```

You can save this program on your disk as PSTRING.COM. Figure 19 shows what the string itself looks like in memory after you use the D command.

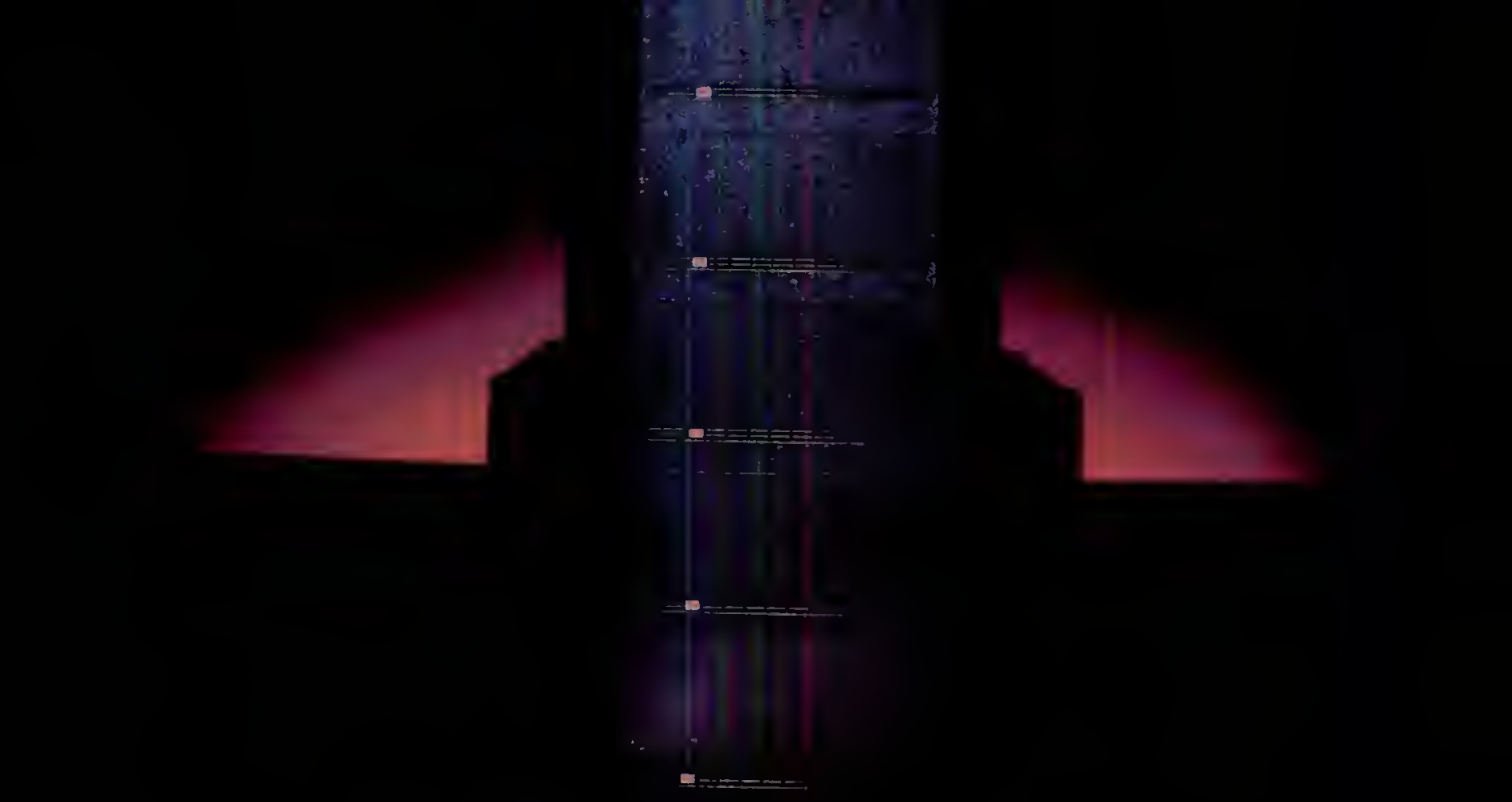
Now you can run the program in the usual way with G and see the entire line of poetry printed out. Notice how short the program is and how long a string it can print out. In fact, the string can be as long as you want. How does this program work?

In the PSTRING program (Figure 18), the square brackets surround not a memory address as they did earlier in the PRINTHI program, but the BX register:

```
0905:0106 8A17  MOV  DL,[BX]
```

This instruction makes use of a special property of the BX register: If you put a memory address in BX, and then use BX with brackets around it in an instruction, references to [BX] will operate *on the contents of the memory address contained in BX, not on BX itself.*

Let's see how this fits into the program. Most of the program is enclosed in a loop, as we can see from the MOV CX,31 instruction at the beginning of the program and the LOOP 106 instruction near the end. Figure 20 shows the flowchart for this



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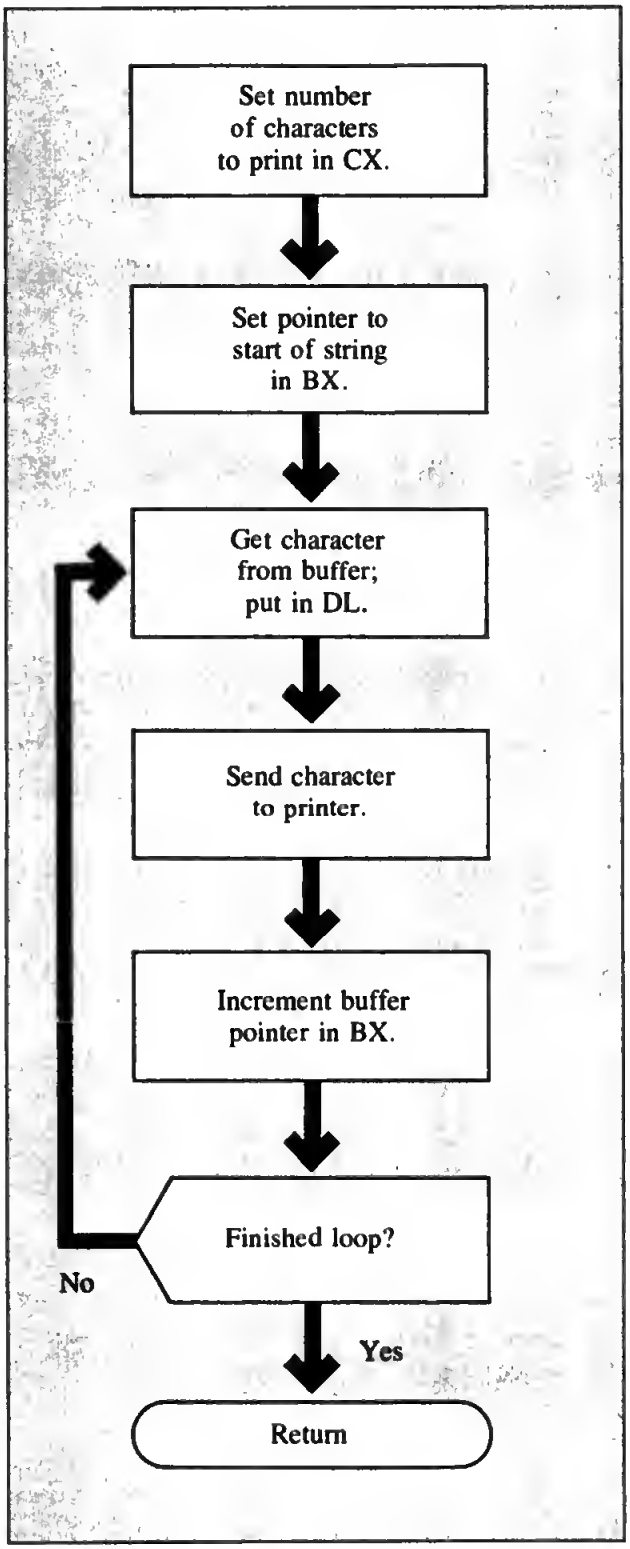

Figure 20: *Flowchart of the PSTRING program.*

program. We put the number of characters to be printed into CX so the loop will be executed this many times, then load the address of the first character into BX so that BX will point to this character. By *point to* we mean that the BX register now contains the memory address of the character. Now, using the square brackets, we write the instruction MOV DL,[BX], which means: "take the character that is in the memory location that is in BX, and put this character in DL." Figure 21 shows how this works.

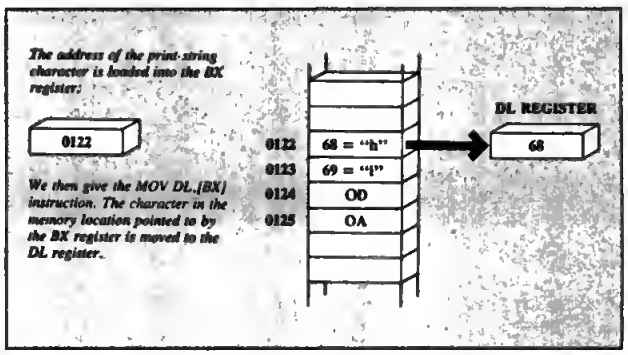

Figure 21: *Operation of the MOV DL, [BX] instruction.*

Now comes the clever part, where we use the real power of indirect addressing. Instead of having to write another instruction to get the *next* character in the string into DL (as we did in the last example), all we have to do is *increment the address in the BX register*, and then execute the same MOV DL,[BX] instruction again. Since the address in BX will now be 112 instead of 111, the character we put into DL will be the h in She instead of the S. We can proceed like this through the entire string, printing the characters until CX reaches 0 and the LOOP instruction no longer causes a jump back to the start of the loop but instead "falls through" (goes on to) the INT 20 instruction, which ends the program. At some point, by the way, when you want to print something on the printer, you'll probably need to turn the program in Figure 18 into a subroutine that can be used in larger programs to provide printer output.

Sending Control Codes to the Printer

While we're on the subject of the printer, let's talk about how to send it control codes. Control codes are one- or two-character codes that tell the printer to do special things like printing condensed, double-width, or emphasized characters; changing the number of lines it prints per inch and the number of characters per line; and skipping over perforations at the end of a page. There are dozens of these control codes, and without assembly language there is really no easy way to send them to the printer. It can be done in BASIC, but that means loading BASIC every time you want to change something in the printer, which can be an inconvenience.

This discussion is geared to the standard IBM dot-matrix

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printer, which is in reality an Epson MX-80. If you are using another kind of printer, the control codes may be different but the principles are the same. You'll simply have to look up the codes in the manual that comes with your printer and apply them as in the following examples.

MODE, a DOS command, can be used to change the characters per line and the lines per inch (vertical spacing) on the printer. To shift into "emphasized printing," we need to write a short routine. In this printing mode, the print head makes two passes across the page, with the paper rotated very slightly in between passes. The result is that the spaces between the dots are filled in, resulting in a much better-looking print, which is sometimes labeled "correspondence quality."

The control code for emphasized print is the ASCII code for escape followed by the code for E, as you can find in the appendix of the printer manual. In BASIC you would send this code to the printer with the statement:

```
LPRINT CHR$(27)"E"
```

The ASCII code for the escape character is 27d.

Figure 22 has a program to turn on emphasized printing in assembly language:

```
-a100
0905:0100 mov cx,2
0905:0103 mov bx,111
0905:0106 mov dl,[bx]
0905:0108 mov ah,5
0905:010A int 21
0905:010C inc bx
0905:010D loop 106
0905:010F int 20
0905:0111 db 1b,'E'
0905:0113
```

Figure 22: *An assembly language program to turn on emphasized printing.*

```
-u100,10f
0905:0100 B90200          MOV     CX,0002
0905:0103 BB1101          MOV     BX,0111
0905:0106 BA17            MOV     DL,[BX]
0905:0108 B405            MOV     AH,05
0905:010A CD21            INT     21
0905:010C 43              INC     BX
0905:010D E2F7            LOOP    0106
0905:010F CD20            INT     20
```

Figure 23: *EMPHAP.COM disassembled with the U command.*

This is exactly the same program as the one in Figure 18, which sent a string to the printer. This version also sends a string to the printer, but in this case the string, in locations 111 and 112, consists of only two characters: a 1Bh, which is the ASCII code for the escape character, and an E, which is the specific character that puts the printer into emphasized mode. Thus we put a 2 into CX at the beginning of the program, since we only want to print two characters.

The U command listing of the program is shown in Figure 23. In Figure 24, we examine the two characters with D.

To try out the program, you can either type G from DEBUG, or you can save the program in the usual way as EMPHAP.COM (for EMPHAsized Print) and execute it from DOS—the obvious course of action if you want to be able to use the program conveniently whenever you want.

When you run the program, the printer may or may not make a little clicking sound. In either case it should put itself into emphasized mode. All subsequent characters sent to it will be printed in emphasized print, as you can verify by typing Ctrl-PrtSc to turn on the printer and then typing something.

If you haven't used emphasized mode before, you'll be amazed at its attractive appearance. Of course it takes twice as

```
-a100
0905:0100 mov cx,2
0905:0103 mov bx,111
0905:0106 mov dl,[bx]
0905:0108 mov ah,5
0905:010A int 21
0905:010C inc bx
0905:010D loop 106
0905:010F int 20
0905:0111 db 1b,'F'
0905:0113


-u100,10f
0905:0100 B90200          MOV     CX,0002
0905:0103 BB1101          MOV     BX,0111
0905:0106 BA17            MOV     DL,[BX]
0905:0108 B405            MOV     AH,05
0905:010A CD21            INT     21
0905:010C 43              INC     BX
0905:010D E2F7            LOOP    0106
0905:010F CD20            INT     20
```

Figure 25: *An assembly language program to turn off emphasized printing, followed by its U command listing.*

```
-d110,11f
0BF1:0110  76 1B 45 C0 A2 70 46 A2-6F 46 A2 6E 46 04 02 A2   v.E@"pF"oF"nF  "
                 :  :                                         \/
                 :  :____letter "E"                           :
                 :                                          ASCII
                 :_______"Escape" code                   equivalents
```

Figure 24: *Using the D command to inspect the ASCII string of EMPHAP.COM.*

long to print everything, because the printing head has to make two passes across the page for every line; but this is a small price to pay if you are writing a letter that may help land you a new job.

Turning Off

How do you get back to normal print mode when you no longer want emphasized printing? Simply send another control code, this time, ESC F. Figure 25 shows the A and U command listings for a program to terminate emphasized printing. As you can see, the program is identical to the EMPHAP program, except that it sends the ASCII codes for ESC F instead of ESC E. The D dump in Figure 26 shows the two characters in the message buffer.

Save this program as NORMALP.COM, for NORMAL Print. Try it out and see how it works. The printer should revert to normal mode.

If you want, you can modify these little programs to do other things with your printer. Sometimes you need to send it only one control character, (instead of the two in these examples), sometimes three. For example, to do double-width printing you need to send three characters: ESC W 1 (that's W followed by the number 1). The ASCII codes for ESC W 0 turn off double-width mode.

Now that you know how to take command of the printer, you'll be in great demand by IBM PC users who want a quick way to tell their printer to change modes and are tired of doing it in BASIC, or not at all. ■

```
-d110,11f
08F1:0110  76 1B 46 C0 A2 70 46 A2-6F 46 A2 6E 46 04 02 A2   v F@"pF"oF"nF  "
                 :  :                                        \/
                 :  :____letter "F"                           :
                 :                                          ASCII
                 :_______"Escape" code                    equivalents
```

Figure 26: *Using the D command to inspect the ASCII string of NORMALP*

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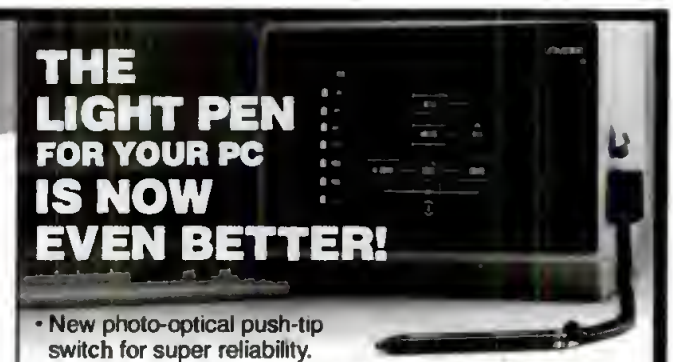

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Business Solutions Announces National Software Challenge

KINGS PARK, NY – Business Solutions Inc. (BSI) threw down the gauntlet today in announcing a six-month $2.5 million integrated software challenge between its Jack2 integrated IBM PC software and major competitors.

"We will take on all existing integrated products, as well as those not yet available. We firmly believe we can show that Jack2 represents a superior approach to integration," says BSI President, Alan Dziejma.

Jack2 will take on the competition in Atlanta, Boston, Chicago, Dallas, Los Angeles, New York and San Francisco between March and May in face-to-face challenges. Demonstrations of Jack2 and its major competitors will be held. The competition will be based on a set of typical business applications identified in a field study conducted by two Harvard Business School graduate students. In addition, business school students from around the country will be asked to test the software while members of the high tech press will be invited to officiate.

"We're confident that Jack2's style of integration represents a thorough understanding of how the typical businessperson gets work done," Dziejma asserts. To back that up scientifically, BSI is sponsoring a study being conducted by Harvard Business School students to identify typical business tasks and how integrated software should be designed to help business users optimally accomplish these tasks.

"We believe this is the first public study to examine the kinds of applications that benefit from integrated software, what those benefits are, and what kind of organizations can make use of them," says Dziejma.

Dziejma urges that anyone interested in the study or challeng
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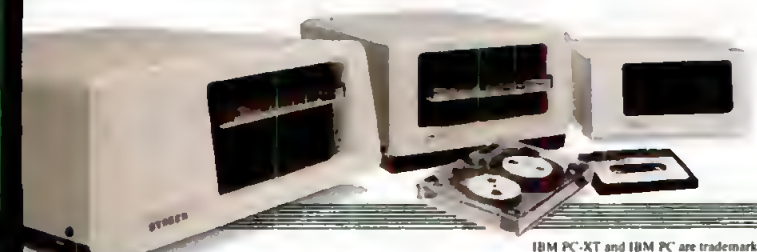

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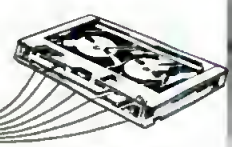

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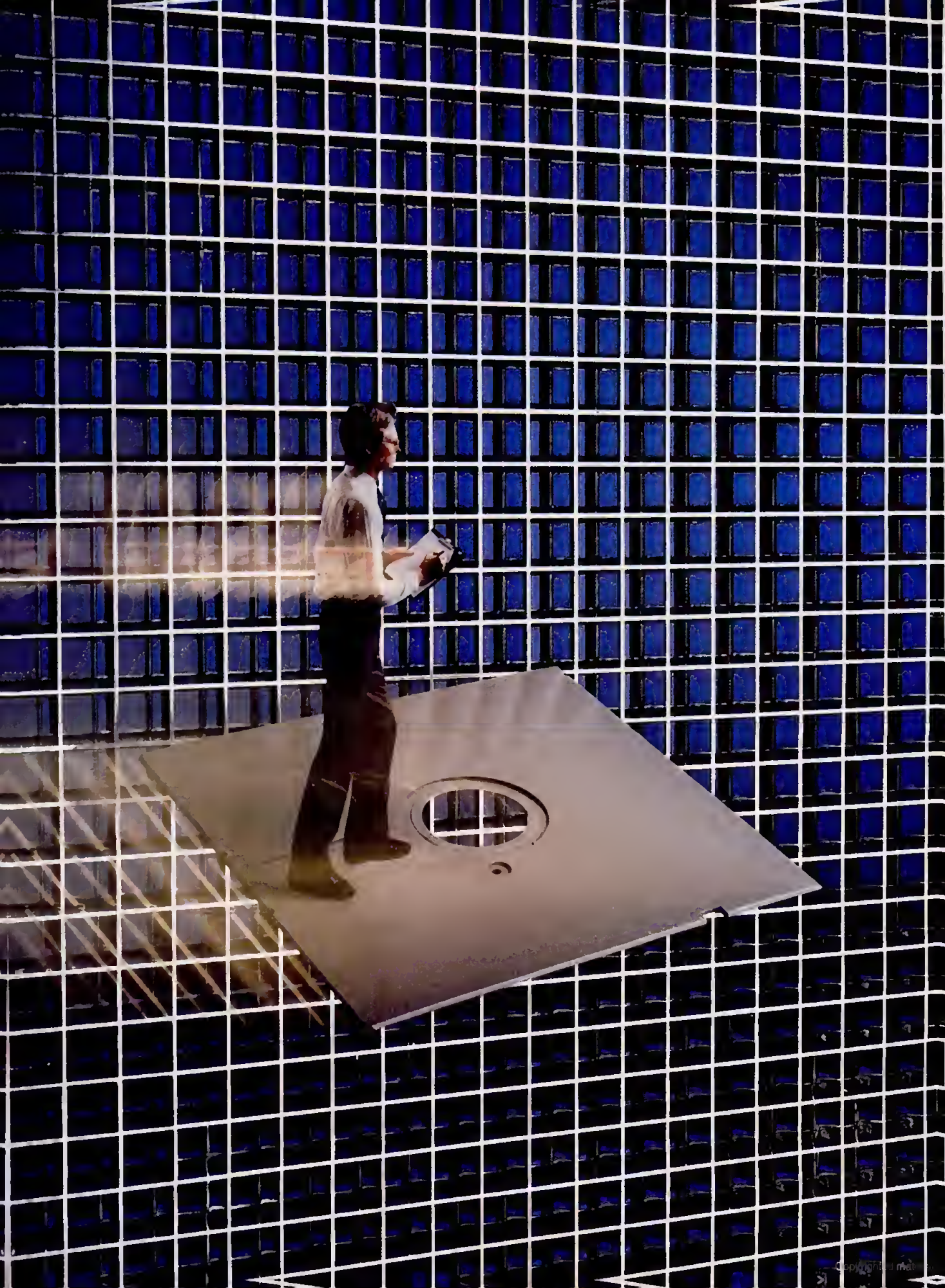
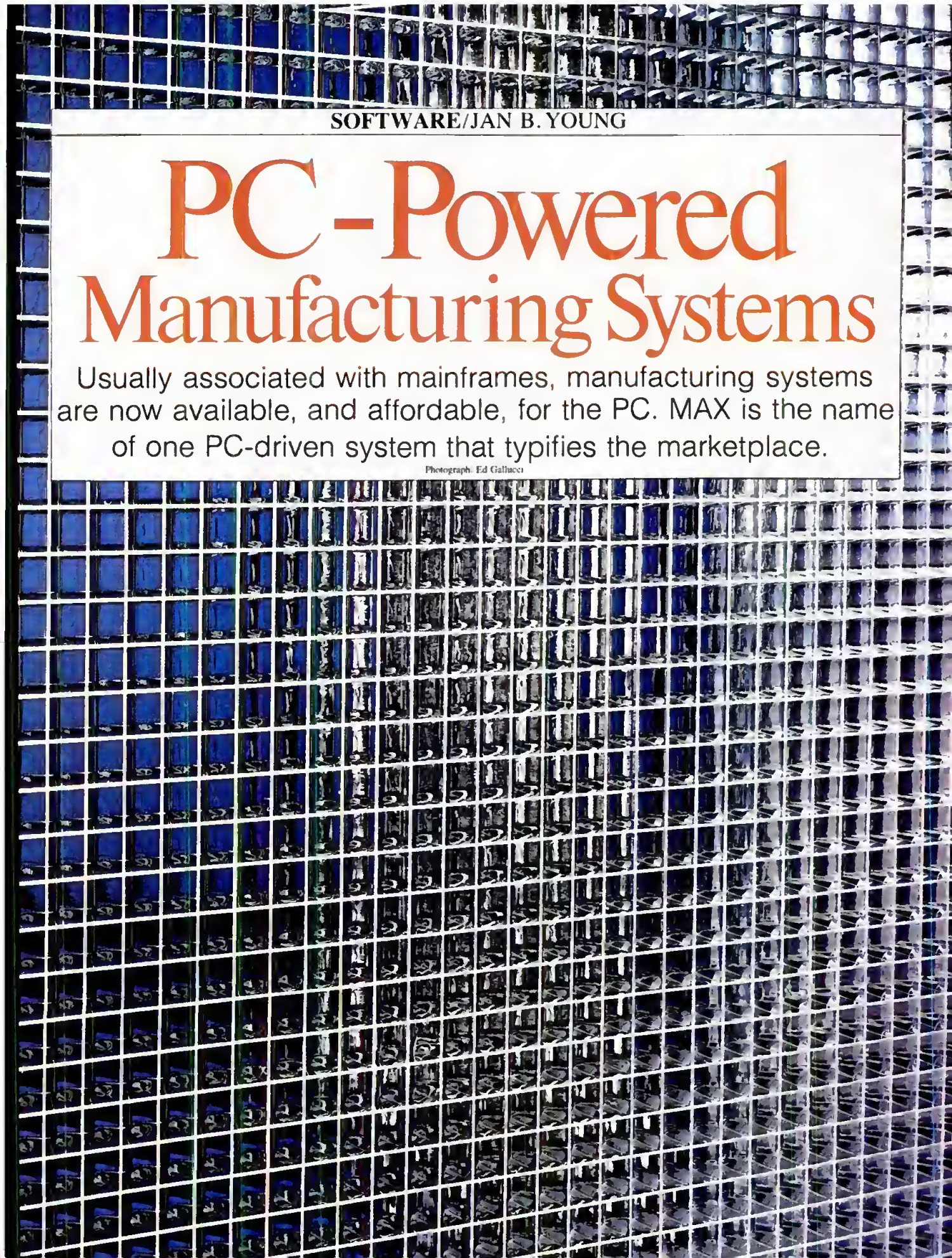


SOFTWARE/JAN B. YOUNG

PC-Powered Manufacturing Systems

Usually associated with mainframes, manufacturing systems are now available, and affordable, for the PC. MAX is the name of one PC-driven system that typifies the marketplace.

Photograph: Ed Gallucci



Personal computers are beginning to take over jobs that have traditionally been the exclusive domain of minicomputers and mainframes. While they aren't likely to replace these more powerful machines, micros are bringing some "mainframe" benefits to smaller companies that can't afford big computers.

One mainframe application that is now available on personal computers, especially the IBM PC, is the manufacturing system. For people in manufacturing, especially small companies, this is exciting news.

A manufacturing system tracks materials through the manufacturing process and analyzes cost and quantity in various ways at each stage. A simplistic way to view it is as a specialized database that stores and maintains information and relationships between pieces of information. For example, a simple question such as, "What job should be done next on this machine?" requires gathering and analyzing an enormous amount of information. An inaccurate answer may cause late deliveries, inefficient use of expensive personnel and equipment, and waste of materials—not to mention unhappy customers. A manufacturing system can take over much of the work entailed in answering such questions.

Manufacturing systems are among the most complex business systems available. On a mainframe, such a system can fill a 30-megabyte disk with programs alone. Mainframe manufacturing software has traditionally sold for $300,000 to $500,000. Minicomputer versions tend to be a bit cheaper, but at $100,000 each they can't be bought out of petty cash, either.

If your manufacturing company does less than $10 million per year in sales or employs fewer than 100 people, a PC-based manufacturing system might be a profitable investment. PC manufacturing systems sell for $5,000 to $20,000 (a system priced at $1,395 is scheduled to be announced soon), which makes these powerful tools available to smaller companies with less capital.

A manufacturing system tracks materials through the manufacturing process and analyzes cost and quantity at each stage.

MAX, the Production Manager
Micro-MRP, Inc.
1065 E. Hillsdale Blvd., #114
Foster City, CA 94404
(415) 345-6000
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Requires: 256K RAM, hand disk, 132 column printer, clock-calendar card recommended.

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Double-Edged Swords

When intelligently used, manufacturing systems can indeed be powerful. They have been known to make and break competing companies. Black and Decker, the power tool manufacturer, was one of the earliest successful users of a manufacturing system. This company has become so efficient that its products are now de facto standards in the power tool market.

On the other hand, one company was run out of business by more efficient competitors while in possession of a manufacturing system that could have made a big difference. That company failed to understand the nature of the system and how to use it. It expected the system to solve the company's problems, but refused to learn how it worked or to properly train employees. Manufacturing systems are truly double-edged swords.

Another inherent problem with manufacturing systems is that they are nearly always incomplete. Due to the rate of change of technology and the complexity of the product, most PC-based systems are constantly being updated, expanded, and enhanced. While all are still missing some important elements, many are now close enough to completion to be useful.

If you think a manufacturing system run on a PC would be a good investment for your company, an interesting one to try is *MAX, the Production Manager*. *MAX* was written and is sold by Micro-MRP, Inc., a new company that derives its name from Material Requirements Planning (MRP), a scheduling technique used in most manufacturing systems. MRP is a proven way to balance minimum inventories with maximum shop efficiency and the best possible customer service; Micro-MRP chose its name wisely.

The version of *MAX* that I looked at consists of seven modules: bills of materials, inventory control, purchasing control, shop floor control, master scheduling, material requirements planning, and a utility module. According to the documentation, Micro-MRP is planning more modules, including accounts receivable, accounts payable, general ledger, payroll, job costing, order entry and invoicing, forecasting, quality control, dock-to-stock, shop-floor data collection, engineering data control, and management performance.

MAX's menus are designed for a monochrome monitor, and on my color monitor some of the prompts appeared in dark blue and were difficult to read against the black background. Otherwise, the system runs easily and smoothly. The three-level menus are consistent across system modules, an important feature. *MAX* provides a detailed audit trail of inventory transactions, but unfortunately doesn't log all transactions.

Now I'll look at *MAX*'s functions, module by module. (See sidebar, "A Glossary of Manufacturing Terms," for unfamiliar words.)

Through the Bills of Material module, *MAX* supports a starting effectivity date, bills of material and bills of resources, scrap factors, and either numeric or percentage quantities-per. It includes the ability to copy a bill of material from one item to another and a standard set of single level and indented explosion and implosion reports. There is no ability to make mass changes to the bill of material file.

The system includes three units of measure: bills of material, cost, and purchasing. The conversion factors between these units must be entered part by part. Compared to a conversion table, maintaining the factors separately for each part is a nuisance, but it may produce more accurate results.

Low level code calculations are separated from bill of material change processes, unlike in most mainframe manufacturing systems. This means that you have to initiate a separate program to update low level codes whenever you change bills of material. While it's a nuisance to remember to start the low level coding process, this approach greatly speeds the operation of the bill of material maintenance program.

The bill of material module includes a simple standard cost accumulation program. It is not a complete treatment and will not satisfy most accountants and auditors, but it may be useful for nonaccounting purposes if you don't have anything better.

Controlling Inventory

MAX's inventory control module is an interactive, real-time, inventory-by-location system. Locations must be predefined and can represent any physical area that can be named in an 8-character field, from an entire plant to a single parts bin. *MAX* is not a complete bin-location inventory system because it does not help you locate empty bins or prevent you from putting more than one part number in a bin.

Inventory control includes a two-step counting procedure. It does not calculate economic order quantities or safety stock quantities but does provide fields for their entry, and the program will recognize these values. Inventory control will perform an ABC analysis but unfortunately you cannot select the break points between classes A, B, and C.

Inventory receipts against an open shop order or purchase order will be received into stock and posted to the order with a single entry. This is a nice feature, although it can cause confusion if the people using the system don't understand it.

MAX should permit you to scrap material directly from stock when necessary and should permit the entry of a scrap reason code. The system supports scrap analysis reporting from shop orders, but not from the stockroom. Scrap discovered in stock can only be removed through an inventory adjustment.

The purchasing module includes a vendor file with room for names, addresses, phone numbers, and contact information. In addition, the vendor file tracks year-to-date purchase dollars and year-to-date order counts. According to Micro-MRP, there is currently no facility to reset these counters at the end of the year, but one will be provided soon.

MAX'S simple standard cost accumulation program will not satisfy most accountants and auditors.

This module also includes a part-vendor file that summarizes purchases of a specific part from a specific vendor, keeps track of the latest prices, and holds other information. This is an example of excellent system design. Unfortunately, Micro-MRP didn't go the second mile; the part-vendor record must be specifically set up before a buy can be made. Some other systems will establish the record automatically if it doesn't exist, saving time and frustration.

Purchase orders can be directly printed as long as you're willing to redesign your form to fit *MAX*'s layout. *MAX* permits purchase order comments, but limits them to 25 characters. Some companies print hundreds or even thousands of characters of variable commentary on routine purchase orders; the significance of this restriction depends entirely on your business.

In addition to purchase orders, *MAX* prints requisition forms, open requisition and purchase order lists, a cash commitment report, and others. The reporting is reasonably complete and nicely done.

On the Shop Floor

The shop floor control module includes a shortage report, but it must be used carefully or it will be misleading. If shortages are reported simultaneously for two orders that use the same components, they could be understated because *MAX* does not reserve or allocate parts. Instead, it calculates shortages assuming that the entire inventory is available for each order.

But there's nothing else in the shop floor control system to carp about. *MAX* uses a technique it calls "order bills" and "order routings." These terms imply that when a shop order is established, a copy of the bill of material and a copy of the routing are automatically made and attached to the order. This is an extremely powerful technique because the order bill and the order routing can be maintained independently of the normal bill and routing. If, for instance, a material substitution is made, the order bill can be changed to reflect the actual material used. If there is a problem with the product later, the record of that order will show the actual materials used. The technique permits very flexible recordkeeping.

The shop floor control module supports firm planned orders and an excellent work center queue display. It collects yield information and maintains a smoothed

A Glossary Of Manufacturing Terms

Like any field, manufacturing has its own lingo. Here are definitions for some of the terms mentioned.

ABC analysis: When a company is dealing with thousands of parts, it can be very useful to concentrate planning efforts on the most important ones and control the rest with minimum effort and expense. Many firms use ABC analysis to achieve this goal. Total annual dollar volume is used as a measure of "importance." Parts are divided into three classes based on annual dollars: Class A parts are the 20 percent that typically consume 80 percent of the cost, class B parts are the middle group, and class C parts are the majority of slow-moving, low-value parts.

Bill of material: Strictly speaking, a list (or bill) of the materials required to make a product. In computer systems, bills of material often show intermediate levels of assembly and are called indented bills. Or they may show only the assemblies and parts directly used, in which case they are called single level bills.

Bill of resources: Assembling a product requires resources other than materials, such as people, tooling, equipment, and floor space. A bill of resources is similar to a bill of material, but is broader in concept. In common usage, it will list all the important and scarce resources required to make an assembly or finished product.

Bucketless MRP: Early MRP systems did not plan by specific date and time, but planned orders only by week. It was soon found that gross rounding errors developed as a result. Modern systems are "bucketless," implying that they plan in increments of time much smaller than a day to avoid rounding errors.

Buckets: Modern manufacturing systems plan future shop and purchase orders based on specific dates and, in some cases, on specific times of day. A shop order, for instance, might be planned to start next Tuesday at 2:46 p.m. This level of precision is necessary for calculations, but most users know that it is otherwise meaningless. For reporting purposes, many computer systems will include the order in a "bucket" of a week's worth of orders, all starting next week. Some systems permit the user to control the bucket sizes on reports, having the current 6 weeks in weekly buckets, followed by two or three monthly buckets, and one or two quarterly buckets.

Economic order quantity: When a part must be purchased or ordered from the factory, it is desirable to balance the economies of scale gained from a single large order against the inventory investment savings gained from a series of small orders. The best balance for a particular part is termed the economic order quantity.

Effectivity date: The date on which a new part is to be used in, or an old part dropped from, a bill of material. Specifying starting and ending effectivity dates in a bill of material allows MRP to plan ahead when the engineering department changes the product.

Explosion and implosion: Bill of material reports which show the components used in an assembly are called explosions. Those that show the various assemblies that use a component are called implosions.

Firm planned order: One major function of MRP is to recommend changes to existing purchase orders and shop orders. If a material shortage is anticipated, MRP will recommend that an order be expedited. If too much material is likely to be on hand at some time, MRP will recommend that an order be delayed. But, sometimes users are swamped with minor recommendations that they don't need. Firm planned orders are simply orders that are encoded so MRP will not make change recommendations for them.

Low level code: A logical way of sequencing the parts on file in the computer for efficient processing. Low level coding is required for both MRP and standard cost accumulation.

Mass change: The ability to update many records with a single input. Manufacturing systems often include the ability to make mass changes to bills of material. For instance, a single user input might substitute part B for part A throughout the bill of material file.

Net change MRP: Some MRP programs reanalyze the entire database every time they are run. These programs are called "regenerative" since they regenerate the entire materials plan. Other MRP programs process only the changes that have occurred since the last run, arrive at a net change, and apply the net change to the old plan to arrive at the new one. Net change MRP is more efficient and faster than regenerative MRP, providing it is run often enough. If run infrequently, the computer may do more work processing the changes than it

would replanning the entire factory from scratch.

Pegging: When MRP plans the production of a single part, it is often useful to know how the completed parts will be used. Some MRP systems can "peg" planned shop orders by specifying which orders will consume the completed parts. Multilevel pegging systems, which can specify which customers will eventually receive the parts, are generally not practical because they consume huge amounts of computer time.

Order bill and order routing: One method of shop order control involves recording and tracking the actual components used in assembling a batch of material and the actual methods used in production. These records, called the order bill and the order routing respectively, are kept more easily if a copy of the standard bill of material and the standard routing are made by the computer when the shop order is created.

Quantity-per: The quantity of a bill of material component used in assembling one item. In a computer system, usually part of the information stored on the bill of material record. Quantities-per are sometimes expressed as numbers and sometimes as percents.

Routing: A step-by-step procedure for making a part or an assembly from its component parts. The routing usually specifies the work to be done, the sequence in which it is to be done, where it is to be done, how much time it should take, and the labor skills required.

Safety stock: Because future demand for products and future supply of materials can never be precisely known, it is sometimes advisable to carry extra inventory as a safety factor against the unknowns of the marketplace.

Scrap analysis: Control over scrap costs can be achieved by recording scrap as it occurs and reporting it periodically in summarized form. The analysis reports often show patterns that can lead to ways to reduce the amount of scrap produced. Scrap analysis usually requires tracking of the quantity and value of the items being scrapped, where they were scrapped, and the reason for scrapping.

Scrap factor: When parts are assembled, the result may not be acceptable. If it is cheaper to throw out defective assemblies than to repair them, the result is scrap. The scrap factor is the expected percentage scrap for an assembly.

Smoothing: A mathematical technique for making short-term demand predictions based on history. "Smoothing" smooths out the "bumps" and works fairly well as a predictor of the future when demands for a part are small and numerous. It does not work well when demands are large and infrequent.

Work center: A group of similar machines capable of doing the same or nearly the same things. Work is considered to queue up in front of a work center, rather than a machine.

Yield: The percentage of parts or assemblies which survive an operation. Calculated as (1.0 - Scrap Factor).—**J.B.Y.**

actual yield on the routing file. Routing maintenance, including a mass-change program, is included in this module rather than with the bills of material.

MAX's master scheduling module is order-oriented. Part number, date, quantity, and order number are kept on file for each requirement along with a few other items of information. The program doesn't support standing orders, so constant reentry of repeating production is required.

> MAX allows the master scheduler to manually maintain forecasts and orders.

This module maintains the master production schedule, the forecast, and open customer orders. In lieu of the promised forecasting and order entry modules, *MAX* allows the master scheduler to manually maintain forecasts and orders. In some businesses, this could involve a massive data entry job. The master schedule report comes out in fixed weekly buckets. Unfortunately, the present version of *MAX* does not permit flexible bucketing.

A resource requirements report that defines the rough-cut capacity required to complete the schedule and gives the master schedule assurance that it is realistic is included. *MAX*'s approach to resource requirements planning is excellent. It permits a multilevel resource bill for each master scheduled part. Resource definitions are entirely up to you, so the report can reflect the key resources your business uses in the way you want them reflected.

MRP and Planning

MAX includes net change, bucketless MRP. This module supports single level pegging, several order policy codes and a shortage report that suffers from the same

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problem as the shortage report in the shop floor control module.

The MRP detail report fails to display some basic information. It excludes the running inventory balance, scheduled receipts, and planned order placements. This must be an oversight; it's too obvious an error to be anything else. Most users should be able to work around the omission without much difficulty.

MAX handles planned orders nicely. When MRP decides that an order must be planned, it sets up a planned order record. This record is later reviewed by the planner and approved. Upon approval, if the item is to be purchased, a purchase requisition is created internally. Or, if the item is to be made, a planned shop order is created. You select vendors for purchased items and convert the same data into a purchase order. A shop planner will review the planned shop order and convert it into a released shop order when the shop is ready to start work. The arrival of the completed material will fill the demand detected by MRP and close the loop. The beauty of this scheme is the passing of data from one function to another without paperwork and with the absolute minimum data entry. This is an example of good system design, which indicates that Micro-MRP has an appreciation for how real factories operate.

Decent Documentation

MAX's documentation rates high. It consists of three well-presented and detailed volumes which, although not indexed, are organized for easy reference. They contain an extensive glossary, report samples, database layouts, a database-sizing worksheet, and a listing of errors with explanations. The manuals explain the operation of the system in detail without using esoteric programming words. The documentation does not attempt to teach production control theory and practice; it also assumes at least a basic understanding of computers.

Accessing *MAX* requires user IDs and passwords. The version I reviewed permits access control only down to the module level, but the next release will extend access control to the individual function.

MAX is copy-protected in an unusual way. Along with your copy of the program you get an EPROM chip that plugs into a vacant socket in your PC's motherboard. Without the EPROM chip, *MAX* won't run. The initial installation of the program is complicated by the need to install this chip, but the manuals give clear instructions, and the installation should go smoothly. The same can't be said for the overly complex license agreement that you must sign to buy a copy of *MAX*. Read and understand it before you sign it. You should also be aware that Micro-MRP does not sell the program source code. What you see is what you get, and if it needs some changes, you're out of luck.

> The documentation does not attempt to teach production control theory and practice.

Nonetheless, the current version of *MAX* is an excellent buy. There are two omissions that are particularly important and need to be addressed in future versions. *MAX* needs a flexible query language and a report writer. Micro-MRP promises an interface to *dBASE II* in the near future, but I'd vote for something more direct. In addition, *MAX* needs complete, detailed audit trails and an improved backup and restore facility.

Micro-MRP deserves credit for what it has accomplished. I'm looking forward to future releases of *MAX, the Production Manager*. ■

Jan B. Young has worked in manufacturing plants and data processing. He currently works for Catalyst, a company that supplies warehousing and distribution computer systems.

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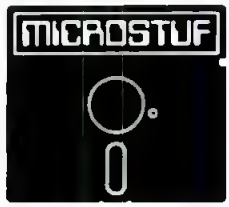

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P.O. Box 5146
Madison, WI 53705
(608) 274-5047
List Price: $325
Requires: 128K RAM (supports 40K documents), 192K RAM (supports 64K documents), two disk drives (drive A must be double-sided) printer.

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***Form Writer* Version 1.1**
Business Development International
P.O. Box 5, Station A
Winnipeg, Canada R3K 1Z9
(204) 837-8509
List Price: $275 (U.S.)
Requires: 64K RAM, two disk drives, printer.

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Until recently, when businesses purchased word processing equipment, most spent $100,000 or more for large Wang, Lanier, Xerox, or IBM systems. These expensive word processing systems offered two advantages that packages for personal computers did not offer. First, they were simple to operate, even for an inexperienced secretary or typist, and second, they had enough features to generate a whole range of business documents from form letters to technical manuals.

But with more and more PCs making their way into big and small businesses, software vendors have emerged with word processing packages aimed specifically at business environments. These new packages are aimed neither at the home user who writes an occasional letter nor at the novelist, whose needs are pretty basic. The real audience for these products is those businesses and individuals who need to generate complicated documents quickly and easily.

Two new word processing packages that claim to address specific needs of businesses are reviewed here. One, *OfficeWriter*, from Office Solutions, Inc. is an easy-to-use word processor modelled after Wang's popular systems. The other, *Form Writer*, from Business Development International, combines database management with word processing to provide a tool for producing form letters and other business forms.

Office Solutions is aiming *OfficeWriter* at businesses that traditionally have purchased Wang and Lanier systems. In this marketplace, secretaries, repro typists, and others without computer experience

(continued)

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are the primary users of word processing systems. These customers want powerful word processing capabilities without having to learn complicated control sequences.

Indeed, *OfficeWriter* operates much like a Wang word processing system. It certainly doesn't have all of Wang's features nor does it have all the features of similar packages for the PC such as *MultiMate* or *Benchmark*. But for the operations that it does perform, *OfficeWriter* is probably more like a Wang word processor than any other personal computer package for the IBM PC. It is extremely easy to use.

Key Assignments

OfficeWriter uses the function keys either alone or in combination with the shift key and the PC's editing keys (arrow keys, Home, End, PgUp, PgDn, Ins, Del, and Tab) to initiate all word processing functions. This means that there are no complicated control sequences to memorize, but it also means that *OfficeWriter* is a relatively simple program, with only a few basic functions available to the user. A list of functions is given in Figure 1.

For cursor control, *OfficeWriter* uses the PC's arrow keys and the Home, End, PgUp, and PgDn keys. There are also keys assigned with the functions Go To Page (F9) and Go To Line (shift-F9). The arrow keys position the cursor to any location on the screen; however, you cannot use them to scroll new text onto the screen.

Pressing the Home key moves your cursor to the first character on the screen. The End key moves the cursor to the last character. PgUp and PgDn take you to the previous and next screens, respectively. These last two functions do not use the slow, line-by-line, screen-filling techniques; they flash an entire screen of text onto the screen. However, execution of the functions themselves can be exceedingly slow on large documents without page breaks. On a 16K document, a 3-second delay between pressing PgUp and having the function executed can be disconcerting. However, putting page breaks in your document speeds the PgUp process considerably.

```
BOLDFACE        CANCEL          CENTER          COMPRESS
COPY            DELETE          DOUBLE WIDTH    END MERGE
EXIT            FORMAT          GO-TO-LINE      GO-TO-PAGE
HELP            INDENT          INSERT          MERGE
MOVE            PAGE BREAK      REPLACE         SEARCH
SUBSCRIPT       SUPERCOPY       SUPERMOVE       SUPERSCRIPT
TAB             UNDERLINE
```

Figure 1: *A list of the functions in* OfficeWriter.

Another problem with using specific keys to control the cursor is that there is no quick way to move the cursor from one end of a line to another. All you can do is press the arrow key and watch the cursor amble slowly into position. However, the folks from Office Solutions say they will fix this deficiency in the next release.

Menu-Driven Operation

Like the Wang system, *OfficeWriter* is menu-driven. To select options, you press function keys listed in the menus. In some cases *OfficeWriter* asks you for more information. After entering the information, you verify that it is correct by pressing the Go key (the large Plus key at the right of the numeric keypad). The Go key is similar to the Wang Execute key and is used to verify many other operations within *OfficeWriter*. If the information you specify is incorrect, you can press the Exit key (F10) to cancel the operation. Should you ever have questions about what to enter, you can press the Help key (Esc), and *OfficeWriter* will display help messages to guide you on your way.

```
Press the Desired Function Key:

F1  - Create a Document
F2  - Edit a Document
F3  - Print a Document
F4  - Manage Documents
F5  - Special Functions

F10 - Exit Word Proceasing
```

Figure 2: *The main menu of the* OffieeWriter *program.*

When you begin, *OfficeWriter* displays a main menu of choices on the screen, as shown in Figure 2.

When you press F1 to create a new document, *OfficeWriter* asks you to enter a one- to eight-character document name and the drive (A, B, C, or D) on which to store the file. (*OfficeWriter* stores documents in DOS files with the extension WP.) If you press F2 to edit an existing document, *OfficeWriter* asks you for the drive and the name you specified when you created the document. If you have forgotten the names of your documents, you can use the Manage Documents key (F4) to obtain a list of documents. *OfficeWriter* does not list existing documents on the main menu.

Pressing F3 allows you to print a document. Once you enter the document name, *OfficeWriter* displays a print menu that allows you to specify almost everything about the printing of the document, including which pages to print, whether headers and footers are to appear, the character spacing, lines per inch, lines per page, and left margin.

F4, in addition to listing the files on your diskette, takes you to a menu where you can copy, rename, and delete documents. From this menu you can also switch diskettes or search for documents.

The special functions selection (F5) takes you to a menu where you can automatically insert page breaks throughout a document, select your printer driver, and set the *OfficeWriter* display option. Selecting the printer driver is extremely easy. The manual includes a special section that

lists the printer features and special installation instructions for each printer supported. My printer, a NEC 3550, worked without problems. Office solutions apparently took special care to ensure that the printer support information in its manual was correct.

Status and Format Lines

When you edit your document, the first two lines of the screen contain the status line and the format line (see Figure 3). The status line lists the percent full, the document ID, the line, the column, and the operation being performed. The percent full column is especially important, because the maximum size of *OfficeWriter*'s documents is based on memory, not on disk space. And, regardless of the amount of memory you have in your system, a document can take up only 64K of memory (30 to 40 single-spaced pages). If you try to perform any operation that would increase the size of your document beyond the limit, *OfficeWriter* warns you without performing the operation.

OfficeWriter also uses the status line to display the status of the Caps Lock and Num Lock keys, since on the IBM PC those keys do not have lights to indicate their status. The PC displays CAP or NUM, respectively, in the upper left-hand corner of the screen to indicate when either of these keys has been pressed. Unfortunately, this information is not as useful as it could be, because the program does not update the status line when you initially press the Num Lock or Caps Lock key. Rather, it waits until you press one of the keys ruled by these two toggle keys. By then it's too late; you already know that you've pressed the wrong key.

The second line contains the initial format line for the document. On this line you can specify the tab settings, the line length, and whether the text is single- or double-spaced. You can place an unlimited number of format lines in your document, and you can edit or delete existing format lines by positioning the cursor beneath the format line and pressing the format key (F4).

OfficeWriter places a default format line on every document you create. You can modify this format line, but unfortunately you cannot change the default that the program uses. Since the default format line permits only 60 characters per line, most users will have to change the format line (and the format lines on the header and footer pages) each time they create a document.

Inserting, Copying, and Moving

OfficeWriter operates almost exactly like Wang systems when inserting, copying, and moving information. To insert information, position the cursor to the place where you want to insert text and press the Ins key. The program clears from the screen all text to the right and below the cursor, except for the first few characters, which it leaves on the bottom line to remind you where you are. Then you can start typing. Your inserted text appears as highlighted (brighter) characters. When you finish your insertion, press the Go key. This causes the "dropped out" text to fill in automatically at the place where you finished typing.

Copying and moving text are similar operations. To copy text, press the Copy key (F8). You can then use the arrow keys to position the cursor, highlighting text as you go, or you can press any other key, causing the cursor to move to the next occurrence of that key. With this feature, you can highlight words by pressing the space bar, sentences by pressing the period key, and paragraphs by pressing the return key.

> The maximum size of OfficeWriter's documents is based on memory, not on disk space.

After highlighting the text you want to copy or move, press the Go key to begin the operation. *OfficeWriter* asks you where to copy or move the text; you move the cursor to that new location. When you press the Go key again, the program copies or moves the text, adjusting the text that follows accordingly; you don't have to perform a separate "adjust" operation.

In *OfficeWriter* the text to be moved remains highlighted until the operation is complete, allowing you to see exactly what text you are copying or moving, even after you press Go the first time. This is one feature that the Wang machines don't offer. However, you cannot move or copy text into this highlighted area.

Like Wang, *OfficeWriter* offers super-

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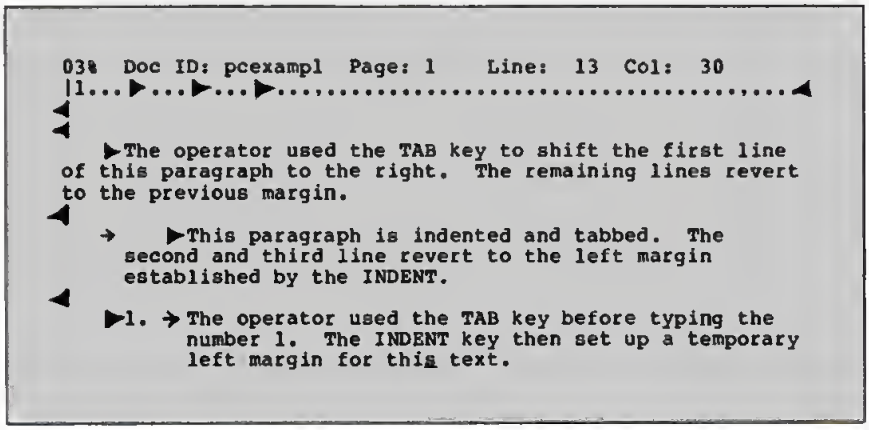

Figure 3: *In* OfficeWriter *the status and format lines appear in the first two lines of the document. Return, Tab, and Indent appear on the screen as special characters.*

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copy and supermove operations to copy or move information from one document to another. The operations are almost identical on both systems, except that with *OfficeWriter*, you are asked for the name of the document into which you want to place your highlighted text.

Tabs and Indents

OfficeWriter contains another important editing feature for people with sophisticated text-formatting needs: It offers both a Tab and an Indent key. When you press the Tab key, the program moves your text over to the next tab location, as specified in your current format line. It also places a tab symbol (▶) immediately before the text. The tab affects only one line of text. Succeeding lines begin at the previously defined left margin.

However, if you press the Indent key (shift-Tab), the program moves your text over to the next tab location and sets that location up as a temporary left margin. This temporary left margin remains in effect until you press the Enter key to end the paragraph. When indenting, the indent symbol (→) appears immediately before the first character of the indented text. Figure 3 is an example of how indented and tabbed text appears on the screen.

> Unfortunately, OfficeWriter does not show the underlining on the screen.

The ability to produce indented text easily is important for many business users, especially technical writers. Most technical manuals require indented text for bulleted items, for numbered steps, and for parameter descriptions, and so forth. *OfficeWriter*'s Indent function eliminates the extensive setup time that many other word processors require for producing indented text.

```
                    PRIMARY DOCUMENT

                                                  KEY
                                              ____________
                                              | ‡  merge     |
                                              | ‡  end merge |
                                              | ‡t title     |
                                              | ‡f first name|
                                              | ‡l last name |
                                              | ‡p position  |
‡t ‡f ‡l                                      | ‡n name of co|
‡p                                            | ‡a address   |
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Figure 4: *Primary and secondary merge documents in* OfficeWriter.

Because *OfficeWriter* places indent and tab characters on your screen (the characters do not appear in your document), you can eliminate the tabbing or indenting easily should you decide it is unnecessary. Simply delete the tab or indent character and the text flows back to its previously defined position. In addition, if you insert a new format line immediately before some tabbed or indented text, the text adjusts automatically to conform to newly defined tab positions.

Special Printing

OfficeWriter gives you an easy way to produce underlined and boldface text (as well as compressed and double-width text on dot matrix printers). It provides a func-

tion key to enable and disable each of these options. For example, to underline a word, press the Underline key (F5) immediately before and immediately after the word. Unfortunately, *OfficeWriter* does not show the underlining on the screen; it places special characters around the text instead.

In addition, *OfficeWriter* provides function keys for search-and-replace operations. As in the Wang systems, these are not very powerful, but they are very easy to use and satisfy most needs.

Headers and Footers

OfficeWriter supports headers and footers in documents, but this feature is one of its weak points. The program allows only one header and footer per document, which you access in the standard Wang fashion by pressing the Go To Page key and then specifying either H (for header) or F (for footer).

OfficeWriter is modeled after Wang's popular systems.

Once in the header or footer page, you have further restrictions. Your header or footer can contain a maximum of three lines. Since you seldom want the first line on the paper to contain text, and you usually want to include a blank line between the header and the text proper, you are actually limited to one line of text in your header. Furthermore, the number of characters in the entire header or footer page (including all characters and spaces in the mandatory format line) cannot exceed a total of 176.

Currently *OfficeWriter* does not support alternating headers and footers. However, this feature is planned for the next release.

When you attempt to print your document, you will notice further restrictions concerning headers and footers. Although you can begin printing headers and footers on any page, both must start on the same page. This lack of flexibility makes it difficult to produce documents such as technical manuals, where the first page usually has a different form of header than the other pages.

Document Merge

To satisfy another common business need, *OfficeWriter* contains a powerful document merge facility. This feature allows you to produce customized form letters, print address labels or envelopes, and fill out any kind of form.

To use the document merge facility, you create a primary document that contains your standard letter or form and a secondary document that contains your list of names and addresses (or any variable data that you wish).

In your secondary document, you assign each unique variable a one-character identifier that you precede with a special merge character (shift-F1). Several variables make up a merge record (such as first name, last name, city, state, and zip). You separate individual records with a special end merge character (shift-F2). Each record can contain as many variables as there are characters (uppercase and lowercase letters count as separate characters), and there can be any number of records.

In your primary document, you define your form or form letter. Instead of listing the variable information in your form, you specify the merge character and the one-character identifier. See Figure 4 for an example of a primary and secondary document.

You merge the primary and secondary documents when you print the primary document. At this point *OfficeWriter* notices that your document contains merge characters, and the program asks you to specify the name of the secondary document to be used during printing. It prints the documents, merging the information from each merge record of the secondary document into the corresponding fields of the primary document.

This document merge capability is already more powerful than Wang's document merge, since it allows you to name your fields. But Office Solutions intends to make it even more powerful. In the next release, it intends to provide a more sophisticated document merge selection in which you can select a subset of your data records based on criteria that you specify. For example, suppose the records in your secondary document consist of names and addresses. You can use the new facility to create a subset consisting solely of those people who live in your own state, or who live in your own city, or who are named, for instance, Steve. This new feature will add a great deal of power to the merge capabilities.

Packaging

OfficeWriter comes in an attractive, small-format IBM-style binder. Included with the manual and diskette are several attractive extras, including a plastic reference ruler (similar to ones distributed by Wang), a set of attractive key top labels, and, for those of you who don't like pasting labels on your keys, a molded plastic function-key template that fits around the function-key pad and lists the operations performed by each key.

The program itself comes on a copy-protected diskette, not the best option for businesses that can't afford the downtime that occurs when such disks inadvertently become inoperable. However, Office Solutions promises a free backup diskette upon return of the registration card. In addition, they will replace, at no charge, any disk that becomes defective during the 90-day warranty period. After 90 days, replacement diskettes are available for a nominal charge. Express mail service is also available in emergency situations.

OfficeWriter comes with a program that will enable you to transfer it onto your hard disk. However, to invoke *OfficeWriter* from a hard disk, you must also mount your *OfficeWriter* program diskette in the

(continued)

floppy drive, so the program can check the copy protection data stored there.

The manual is clearly written and easy to follow. It uses many of the formatting conventions established by the IBM PC manuals, so that readers who are familiar with the *Guide to Operations* manual will have no trouble finding information. It uses large section headings to separate the information logically, and it uses green letters when listing screen displays.

The manual includes a tutorial and an advanced tutorial that lead you through every feature of the product. The tutorials are written so that anyone, even someone who has never used a computer before, can follow along and learn. After finishing these two sections, even the most naive user will know almost everything there is to know about *OfficeWriter*. But, if you forget how something works, the reference sections list functions in alphabetical order for easy access.

Most businesses who buy word processing equipment do not want to invest time and resources in maintaining and debugging their systems. They want turnkey systems with reliable support from the manufacturer. Office Solutions seems to be genuinely concerned with providing that support. It offers training materials, publishes a customer support hotline number in its manual, and plans to notify users when new releases become available. In addition, the company will sell the product on a 30-day trial basis so that businesses can evaluate it in-house before making the commitment to buy.

What's Missing?

Even though *OfficeWriter* has many of the features needed in the office environment, the current version (1.0) lacks several features that are standard on many other word processing programs. Before buying it, you should consider whether you can live with the following limitations.

- No half- or quarter-spacing;
- No horizontal or vertical scrolling;
- No simultaneous editing and printing;
- Document size limited to 64K RAM;
- No decimal tabs;
- No column manipulation;
- No Wang-like glossary functions (batch files within the word processor);
- Limited header and footer capability (one each per document, three-line maximum length, no alternating headers and footers);
- No utility to transform documents to ASCII files and vice versa;
- No right justification.

For many businesses, these deficiencies will be significant enough to prevent them from buying *OfficeWriter*. However, the people at Office Solutions do not intend to sit still.

> Most businesses want turnkey systems with reliable support from the manufacturer.

Version 2.0 of *OfficeWriter* promises to be available this month. This version will address many of the deficiencies present in the current version. In particular, document size will be based on the amount of memory in your system and will not be limited to 64K. This updated product will support right justification, decimal tabbing, column move and copy, soft hyphens, horizontal and vertical scrolling, and simultaneous editing and printing. In addition, it will contain a document-to-ASCII/ASCII-to-document utility that will allow you to transmit documents via modem to another computer or typesetter, read in documents produced by other word processors, and read in data from a spreadsheet and integrate it into your document. These new features, along with the previously mentioned improvements to the document merge facility, could make *OfficeWriter* one of the better products on the market.

If you purchased version 1.0 before January 1, 1984, Office Solutions will send you the version 2.0 package free of charge when it becomes available. It also plans to offer further updates to current users at discounted prices.

Form Writer

The idea behind *Form Writer* is a good one: combine a database manager with a word processor to obtain an intelligent form-letter generator. And, if the developers had followed through with either an easy-to-use program or a feature-laden one, *Form Writer* might have become an indispensable tool for certain small business-people. However, the program is neither easy to use nor feature-rich.

Form Writer is really two programs in one. The first is a records program that allows you to set up a database (usually a mailing list with additional information) and select "batches" of records from the database by using string-searching techniques. The second program is an editor that allows you to create form letters with variable fields and print those letters, filling the variable fields with data from the "batch" of records previously selected.

As a database manager, *Form Writer* limits the lists (or records) of information to ten fields, each of which can contain a maximum of 40 characters. This limitation excludes a number of useful business applications, such as payroll or employee records. As a word processor, *Form Writer* limits documents (called forms) to one page. That's right, one page. Therefore, it cannot possibly be considered a general-purpose word processor, even though the manual claims that *Form Writer* generated all the text for the manual.

To use *Form Writer*, you must initialize three diskettes, for the program, the records, and the forms, respectively. The program diskette contains most of the program files that make up *Form Writer*. The records diskette contains your database records, while the forms diskette contains your word processing files—the form letters.

When you are creating records, mod-

ifying information contained in them, or creating batches of records, your program diskette must be in drive A and your records diskette in drive B. For word processing functions, your forms diskette (and sometimes your program diskette) must be in drive A, while your records diskette remains in drive B. This setup requires a lot of disk swapping, especially during word processing operations. Most of the swapping seems unnecessary, but the program gives you few alternatives. If you have double-sided drives, you can copy your forms diskette and program diskette onto a single diskette, but that cuts down the space left for documents. The manual claims that hard disk or RAM disk use is possible, but the version I tested, Form Writer 1.1, has no provisions for specifying which drives contain the individual diskettes. Unless you set up DOS so that it thinks a RAM disk or hard disk is drive A or B, you cannot use these forms of storage.

Setting Up Your Records

When you initialize your records diskette, you must describe the structure of the records to be contained on the diskette. *Form Writer* prompts you for this information. You must specify names (limited to 40 uppercase characters) for each of the ten fields, and you must define the length of each field (40 characters is the maximum length). Figure 5 shows the menu that you use when setting up your records.

```
YOUR LIST CAN HAVE AS MANY AS 10 FIELDS, EACH WITN UP TO 40 CNARACTERS.
THE FIELD TITLE DEFAULTS ARE:

FIELD #1  20  LAST NAME OF INDIVID     FIELD #6  40  STREET ADDRESS_____
FIELD #2  40  FULL NAME OF INDIVID     FIELD #7  25  CITY STATE OR PROVIN
FIELD #3  20  OEAR FIRST OR LAST__     FIELD #8   7  ZIP CODE OR POSTAL C
FIELD #4  35  TITLE OF INDIVIDUAL_     FIELD #9  30  BUSINESS CODE PHONE_
FIELD #5  40  COMPANY NAME_____        FIELD #10  7  AMOUNT OWING_____

TYPE TNE NUMBER OF THE FIELD YOU WISH TO CNANGE, OR THE ESCAPE KEY TO CONTINUE.
```

Figure 5: *Menu for setting up* Form Writer *record definitions.*

```
                X<>X<>X<>X<>X<>X<>X<>X<>X<>X
                X<                         >X
                X<      BDI Form Writer    >X
                X<                         >X
                X<        MAIN  MENU       >X
                X<                         >X
                X<>X<>X<>X<>X<>X<>X<>X<>X<>X

     F1  Select Record              F2  Select Batch File

     F3  Change Record              F4  Edit Batch File

     F5  Delete Record              F6  Delete Batch File

     F7  Add Record                 F8  Form Writer

     F9  Backup Disk                F10 Change Records
                                        Diskette

                    October 2, 1983     11:07:54
```

Figure 6: *The main menu from the* Form Writer *program.*

This figure contains the default record definition that *Form Writer* provides. The default record definition will probably handle most form-letter applications, although you can change it to meet your needs.

The program limits you to one kind of record per records diskette. If you need to create a record with different kinds of fields, you must initialize a new records diskette for that new kind of record. Because of this limitation, you must plan ahead before setting up your records diskette. After initialization, you won't have any facility for adding new fields or changing their definitions.

Once you define the fields in your record, *Form Writer* allows you to enter default values for the fields. For example, let's assume that your record description is the default one, as shown in Figure 5. If most of your customers reside in New York, New York, you can include this as the default for field #7 (CITY STATE OR PROVIN). Later, when you go to add records, the program will automatically fill in the field for you with the default value. If you don't want to use the default value, backspace over it at this time and fill in the value you want. You can provide full or partial defaults for all the fields in the record definition.

Database Management

After you initialize your records diskette, *Form Writer* takes you to the main menu, from which you can perform many database operations or access the editor to create your form letters. Figure 6 lists this main menu. Since each function available from the main menu is associated with a function key, performing a function involves only a single keystroke.

For a new records diskette, the first thing you will want to do is add records to the program. To do so, press the F7 key. *Form Writer* then prompts you for the fields of information, using the names you specified when you initialized the forms diskette. It lists the name of the field and a line in which you can enter a value for the

field. If there is a default value, it lists that too. Once you fill in the value for the field and press ENTER, *Form Writer* prompts you for the value of the next field. In this manner, you can enter your entire mailing list (or other records of information).

Since *Form Writer* prompts you for each field by name, adding records is an operation that anyone can perform with little knowledge of the program.

Batch Files

The most powerful feature of *Form Writer* is its ability to group several records into a single batch, based on criteria that you supply. For example, suppose you want to send a form letter to all people in your database that live in the state of New York. You create a batch file that includes all records containing the words "New York" in field #7.

List up to five strings that occur in field #7, identify the field you want to search, and indicate whether the string is optional, mandatory, or undesirable. The more search strings you specify, the more selective you can be about the records that appear in the batch file.

For example, suppose you want a list of all doctors in your database who live in either New York or New Jersey and who do not owe you money. To obtain this list, you would create a batch file with the following search strings:

- "New York" in field #7 as an optional search string.
- "New Jersey" in field #7 as an optional search string.
- "Dr." in field #2 as a mandatory search string.
- "$" in field #10 as an undesirable search string.

Once you specify all your search strings, *Form Writer* creates a batch file containing all records that meet these requirements. You can then print forms using the information in your batch file to fill in the variable fields in the form.

Even though the introduction portion of the manual says that you can create unlimited batch files, you cannot store more than ten on one records diskette. The manual doesn't state this clearly, nor does it warn you what *Form Writer* will do should you attempt to create more batch files. If you try to create more than 10, *Form Writer* will whir and buzz along, as if it's doing what you asked. But then it returns an obscure numbered error message that the manual says should never appear. After this, your records diskette will be unusable—a serious bug that will be corrected in future versions.

Another problem with batch files is that the program does not automatically update them when you add records to your database or change information in existing records. This means that you have to recreate your batch files whenever you change your database. Recreating batch files is relatively easy, but *Form Writer* should provide you with the means to save the search strings you used when creating the batch file. The current version, unfortunately, does not.

Since Form Writer prompts you for each field by name, adding records is an operation that anyone can perform.

The Form Writer Editor

The word-processing portion of *Form Writer* (the editor) is rudimentary at best. It provides standard word processing options—facilities to insert text or a variable field, delete text, center, underline, boldface, set up tabs and margins, right-justify text, and print documents. However, using these features often requires several hard-to-remember steps. The program displays text on the screen as it will appear on the paper, including underlines and boldface, but it supports only one-page documents. This should help keep business correspondence down to a minimum but is hardly satisfactory. Currently *Form Writer* doesn't provide any mechanism for copying or moving information from one document to another. Obviously it doesn't number pages.

Each forms diskette is associated with a single records diskette. The editor allows you to insert into your form letter the variable fields you defined in your records diskette, which allows you to print out batches of personalized form letters. To insert a variable field, place your cursor at the point in the document where you want the insertion to occur; then press F9. The editor will display the list of record fields defined for your record diskette, and you can choose one by entering its number. The editor then inserts an identifier for that field into your document. The identifier consists of the field name and a number of diamond characters, which fill out the identifier to the number of characters in the field length.

Once you have created your form letter, you can print it by pressing shift-F2. However, if your document contains variable fields, you should go to the main menu and select a record or batch of records before printing the document. Once you have made your record selection, you can go into the editor and print your document. *Form Writer* will print as many copies as there are records in your batch, inserting the variable information from the batch into the form letter.

Printer Setup

The earliest version of *Form Writer* supported only the Diablo 630 letter-quality printer, but the current one, version 1.1, supports a few other printers and provides generic printer support. However, setting up the program to support your printer can be confusing and frustrating.

You can specify information about your printer when you initialize your records diskette or from the main menu (by pressing Ctrl-Home). When you change the printer information, *Form Writer* asks many questions about your

printer, most of them confusing. In one case, it claims that it will list the information that it assumes about your printer; if you continue, it asks you questions without displaying default values. This omission is unacceptable in a business environment, where many of the people who use the program know very little about computers. Version 1.2 of the product will address the problem of printer defaults, but until then, users will probably have to experiment with the parameters until their printers work or call Business Development International for assistance.

> The word-processing portion of Form Writer is rudimentary at best.

Documentation

The program and manual come in an attractive binder and box combination that will blend in well with the rest of the PC packages on your shelf. However, beneath the slick exterior lies a crudely produced and poorly organized manual. The pages are printed on several different colors of paper so that you can distinguish the introduction, tutorial, reference, and appendix sections from one another. However, much of the essential reference material is described only in the tutorial section, a section that is not structured for easy reference.

The manual contains many forward and backward references, forcing the reader to scurry from one page to the next. In addition, the reference section is organized by subject, rather than by function key or menu. This arbitrary organization is confusing, since subject names are not uniform. A topic may not be listed under the titles you would expect.

The package also comes with a quick reference card that is of little use. Most of the card is devoted to tips about diskette handling, daily backups, and disk full procedures—information that would be better presented in the manual proper. Another large section of the card is a table of contents for the reference section of the manual—further evidence that the section is poorly organized. Only a small part is devoted to function key definitions, and it mentions only those used in the editor.

Conclusion

Form Writer does what the manufacturer claims it will do, but it is tedious to use and doesn't take the necessary precautions to protect users from their mistakes. Protection is of the utmost importance in a business environment, where several people may use the same program at different times, and where a damaged records diskette can have an immediate effect on profits.

Furthermore, *Form Writer* is downright unfriendly at times. On more than one occasion it asks you for information you just finished entering. Also, when you specify the size of the margins of your paper, you must specify the top and bottom margin in inches (0.167 inches per line) instead of lines. The manual does include a table that tells you how to convert lines into inches, but the program should be able to do that itself.

These deficiencies reflect poor planning on the part of *Form Writer*'s designers. Omissions such as these might have been acceptable in a product intended only for casual users or hobbyists, but the business marketplace as no place for such a sloppy product.

OfficeWriter, on the other hand, lives up to the high standards businesses expect. The program is easy to use and the documentation is slick and professional. If it has a major fault, it would be lack of features. Users expect more from a $325 word processor.

However, if the manufacturer adds as many features to *OfficeWriter* as it promises and if it provides sales and service support geared toward the business professional, *OfficeWriter* may become a leader in the office word processor market. ■

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Tom Christopher uses a PC and some sophisticated hardware and software to create his computerized masterpieces.

Just as many people see beauty in the irregularities and flaws of woodblock prints, others like computer art for its crude, machine-generated appearance. The texture and line of the medium is its attraction. However, advanced equipment is now capable of airbrushing and blending fine tones to completely mask the computerized look.

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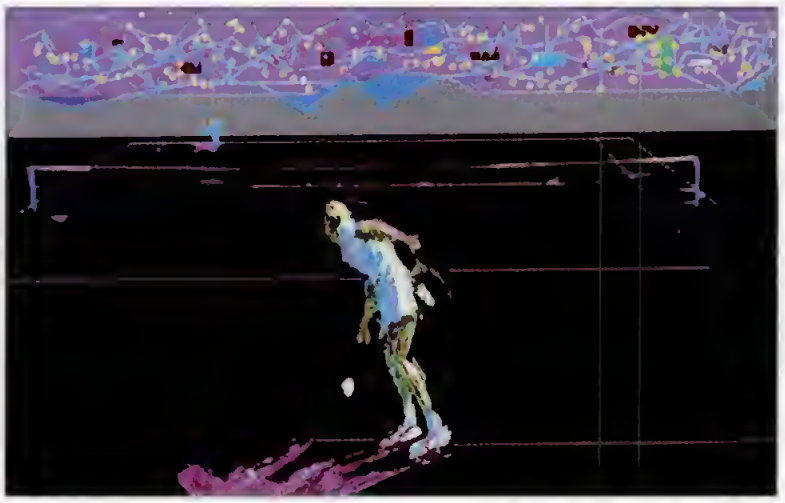
To make the transition to computer art, it helps to be flexible and have a wide vocabulary in all types of flat art, including drawing, graphics, and typography. I received my formal art training at the Art Center College in Pasadena, California. Since then, I've held a variety of jobs in the art field ranging from watercolor portrait painting at Disneyland to album promotion and merchandising at CBS Records. I've designed posters, record covers, and book jackets; built window displays of 7-foot-tall robots; illustrated cars for *Motor Trend* magazine and criminals for CBS News; done courtroom drawing; had a brief stint at NBC Studios

(continued)

Advanced equipment is capable of airbrushing and blending fine tones to mask the computerized look.



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The available functions include line, fill, zoom, stamp, and open or closed circles of any diameter.

doing "Tonight Show" slides; and covered sports events from Grand Prix racing to Soviet hockey.

An Expensive Paint Box

The first time I used a computer was at ABC Sports. While testing for possible Olympics work, I had a chance to use a Quantell Paint Box for a few days. The Quantell is a fantastic graphics machine requiring approximately the same amount of power as is needed to light up the city of Las Vegas and costing a little over a quarter of a million dollars—rendering it slightly impractical for home use. More recently, I've had a chance to try a more accessible computer graphics system.

The New England Technological Group, a software development company located in Wobum, Massachusetts, sent me a prototype of its new Tech-Graphics 2 system. The system centers on an IBM PC, into which is hooked a high-resolution Conrac monitor, a Corvus hard-disk system capable of storing 5 megabytes of information, and a digitizing graphics tablet and pen.

The information gathered by the PC is fed into an Intelligent Graphics Terminal (IGT), a 1024 × 780 frame buffer produced by Jupiter Systems. The IGT takes the information supplied by the PC and transforms it into color video signals that appear on the monitor.

The graphics tablet is a chunk of plastic about 17 inches square (artists might want to place a sheet of acetate on the tablet for a faster surface). You draw with a stylus resembling a fat Pentel pen with a cord attached.

The cursor moves on the monitor as you manipulate the stylus. In order to choose a function from the menu you move the cursor, either by using the stylus or by pressing the letter *M* on the keyboard.

The available functions include line, fill, zoom, stamp, and open or closed circles of any diameter. Fill is used to color or recolor an area and as long as the desired area is completely contained, it's easy to exchange one even tone for another. However, if there is a leak of even one pixel, it can be a disaster—you have no choice but to sit back and watch color run rampant across your screen. The zoom function enlarges a portion of the work up to 16 times. An artist might use zoom to surround areas or lines with tones to give a soft edge, or to detail a small area and then bring it back down to its original position in the design. Stamp repeats simple or complex colored images.

On the bottom of the screen is a long band displaying the range of 256 colors available. When you move the cursor to a selected position on that band, that area is magnified and you can then choose the exact color you need.

Colors are formed in the edit mode, which brings the palette up to cover the entire screen. Every color can be instantly analyzed for hue, value, saturations, and the percentage of red, green, or blue it contains. Theoretically, 16 million combinations are possible. Each palette is stored and automatically travels with the picture it was used for.

Defying Natural Laws

When dealing with a computer, it's interesting for an artist to note that traditional laws of nature do not always apply. For instance, the "paint" will not drip or settle in one area, colors will not fade or dry, and there will be no bubbling or dulling of differences in surface saturation. There is no dominance of one color over another. Therefore, pastel tones can easily cover or take the place of dark colors; to the computer each color is just another number. In addition, drafting tools such as T squares and french curves are unnecessary, since their tasks are performed electronically.

One of my favorite features is the color matrix rotation function. Once a design is on the screen, the entire color scheme can be altered by using this function to "rotate" the palette. Each on-screen color will then change to the color that is next in line on the computer's palette. Although

the manual refers to it as "more of a toy than a utility," I found the rotation function one of the most useful in the system. It opens up a multitude of color strategies and combinations—you could lock an artist in a room with the same design for 5 years and not come up with some of the stunning combinations the computer could generate in 10 minutes.

It's a good idea to save all work every 20 minutes or so. There's nothing worse than watching your efforts destroyed by a glitch.

It actually took me about a week to become fully comfortable with the computer. The storage and retrieval functions took a while to learn—I was forever losing images by changing functions at the wrong time or accidentally erasing the screen. Before this I had never really worked with a computer. In short, if I could catch on, anyone can.

My experience in figure and life drawing helped, since I was accustomed to drawing while not looking down all the time. When drawing on the computer, the artist moves a stylus on one surface as the image appears on another, which can be disorienting.

Like most artists, I tend to get assignments with very short deadlines, ranging from overnight to a few days. Using the Tech Graphics I, the picture of Count Basie, which was executed for CBS records, took about 2 hours to complete. I used the rotation function, instead of the usual marker comps (tests using magic markers) and acetate overlays to test color. Since the original was stored in the machine, there was no fear of losing it in the middle of some catastrophic experiment. It would have been impossible to get decent results in the same amount of time using normal tools like a Rapidograph, watercolor, or Pantone paper. Since that would have involved hours of cutting time or laying in washes, experimentation would have had to be kept to a minimum.

> The Quantell is a graphics machine costing a little over a quarter of a million dollars.

In the Mood

The drawings of the tennis players began as sketches made at an intensely competitive tournament at the National Tennis Center. Translating the sketches onto the computer later, I tried to catch the mood of the final Connors/Lendl bloodbath with clashing reds and greens, the fury of McEnroe by drawing his face against a violent geometric background, and the brooding Bill Scanlon with closely related browns and reds. The computer's hard-edged style and intense colors made it the perfect medium.

I had an assignment for *Fortune Magazine* to convey the idea that the smokestack industry is making a comeback in America. I executed a single black-and-white drawing, dropped in color with the computer's fill function, and rotated the color quickly to produce a series of varied effects with the basic design.

I find the computer the most innovative, flexible, and creative medium to come along in this century. And as computers become less expensive and more powerful, they will also become more capable of taking repetition and drudgery out of art production. ■

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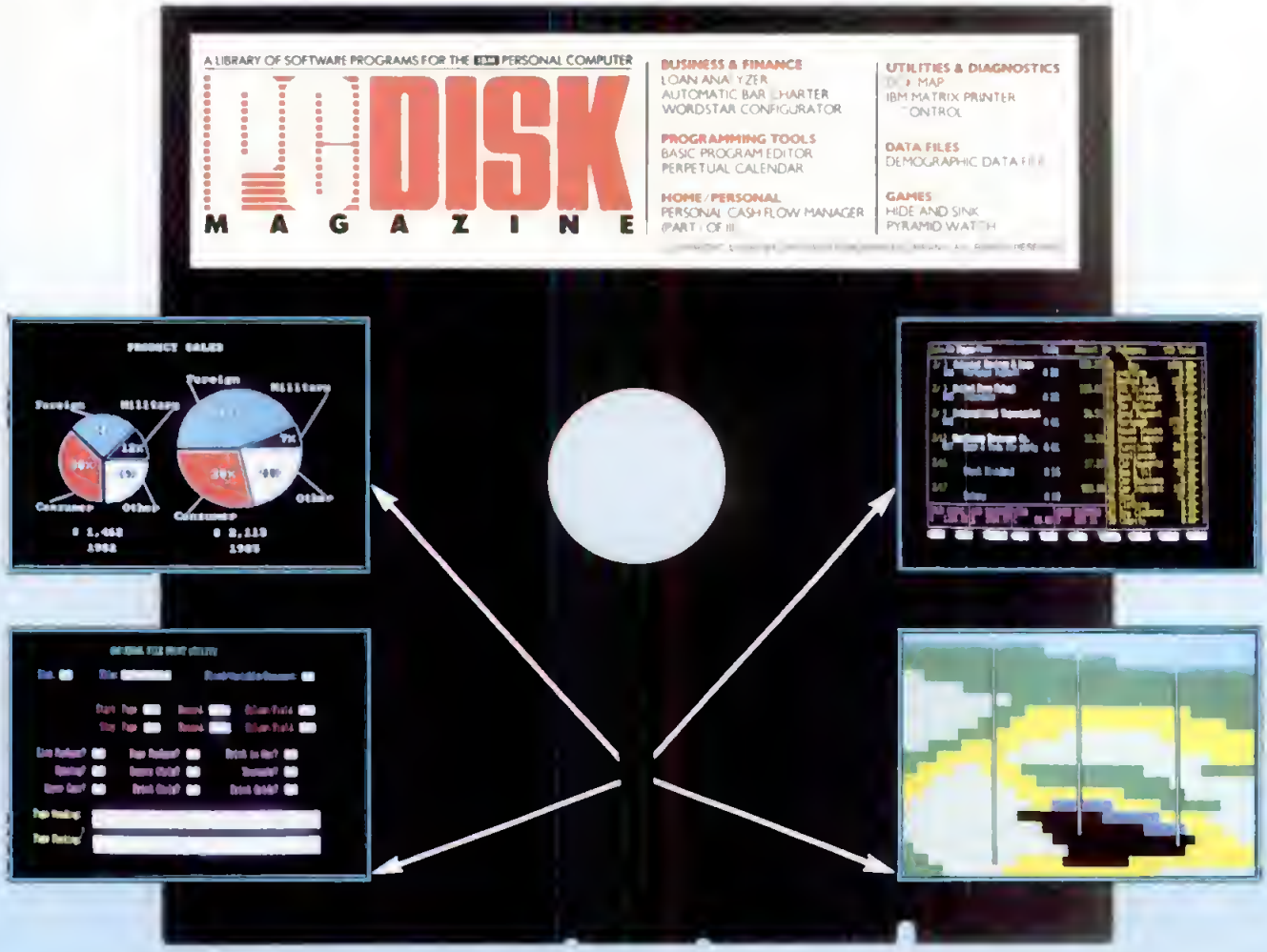

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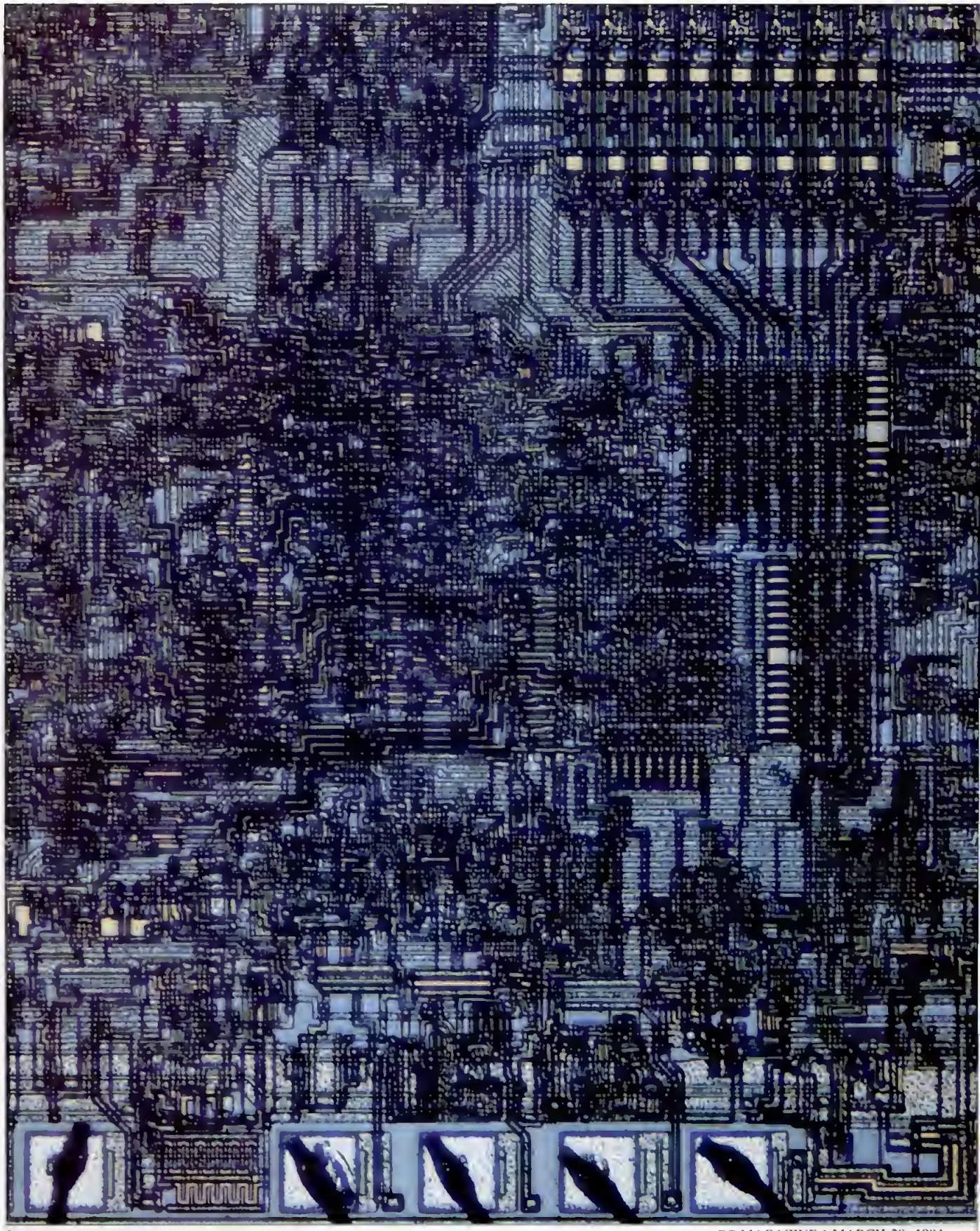
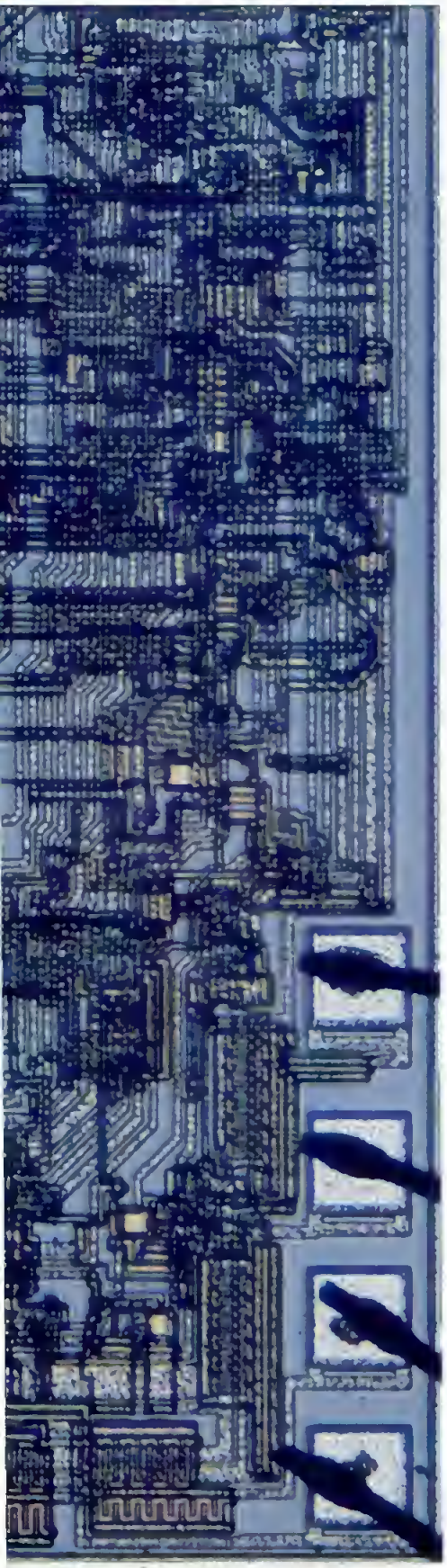




An Illustrated History of the Chip

Part 2

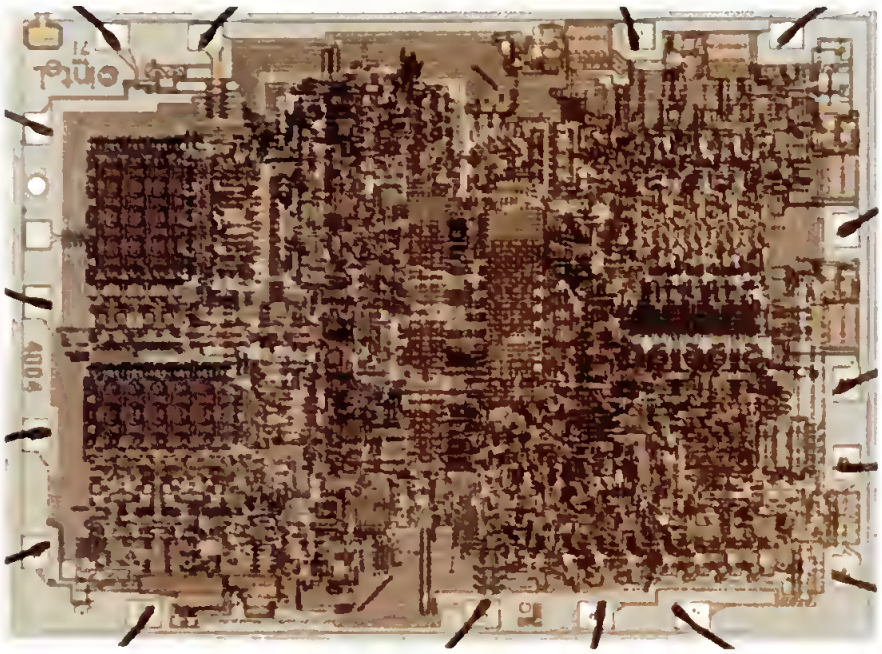
Photographs and text excerpted from State of the Art depict the "coming of age" of the integrated circuit.

State of the Art: A Photographic History of the Integrated Circuit
Stan Augarten
Ticknor & Fields, New York, 1983
xvi, 80 pp., hard cover, $17.95

CIRCLE 742 ON READER SERVICE CARD

A detailed view of the first general-purpose microprocessor, the 8-bit 8080. Intel's innovative and widely used microprocessor can execute about 200,000 operations a second.

Excerpted from the book State of the Art *by Stan Augarten, published by Ticknor & Fields, New York, a Houghton Mifflin Company. Copyright © 1983 by Stan Augarten. Reprinted by permission of the publisher. This second of three excerpts covers the history of the chip from the appearance of the first microprocessor, the Intel 4004, to the 1977 development of the programmable logic chip.*



1971

The First Microprocessor: The 4004

INTEL

In the summer of 1969, Busicom, a now defunct Japanese calculator manufacturer, approached Intel with a contract to design a set of chips for a family of high-performance programmable calculators. The Japanese wanted to develop a calculator that could be plugged into printers and electronic displays, as well as perform ordinary mathematical chores; they intended to make the machine programmable by providing specialized sets of ROMs that could be inserted in the machines. These ROMs would contain the instructions for the calculator's logic chips.

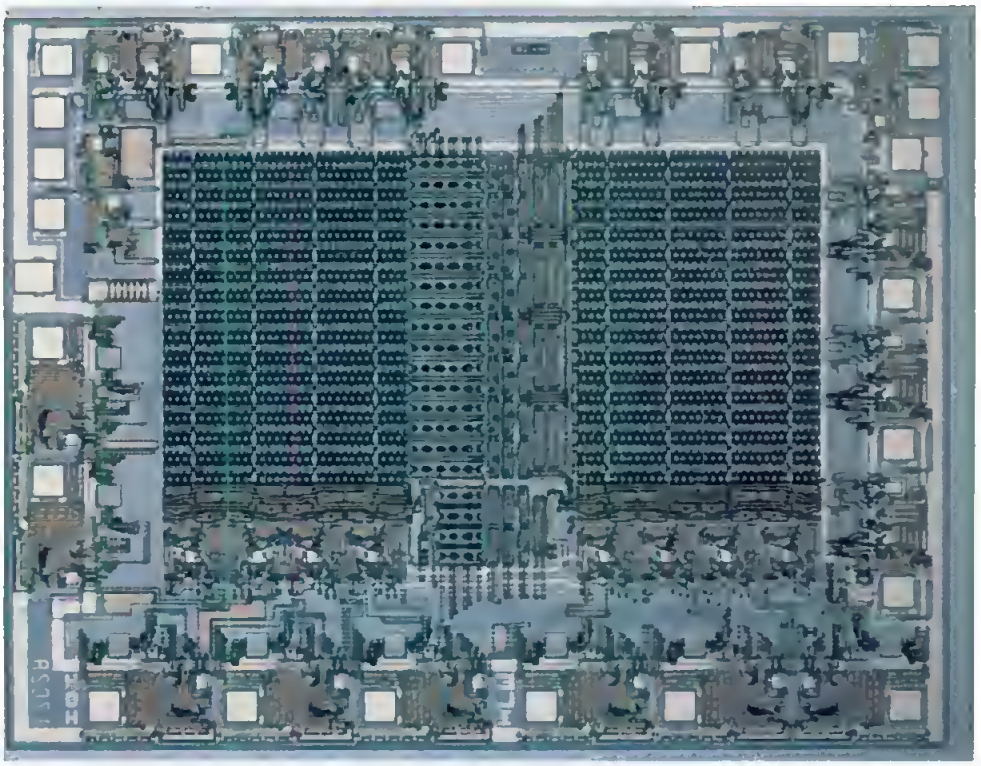
In Busicom's original design, the calculator required at least twelve memory and logic chips, each consisting of an unusually large number of leads. In the late 1960s, when Busicom approached Intel, the technology for making relatively intricate ICs had been around for only a couple of years. The ICs of the time were all hardwired—that is, they generally contained a fixed number of logic gates, which could perform only certain functions.

A young Intel engineer named Marcian E. (Ted) Hoff, Jr., was assigned to the Busicom project. Hoff thought that Busicom's design was too complicated and cumbersome to be cost-effective, so he came up with a novel alternative. "Instead of making their device act like a calculator with some programming abilities," he recalled, "I wanted to make it function as a general-purpose computer programmed to be a calculator."

To this end, Hoff and fellow engineers Frederico Faggin and Stan Mazor whittled the twelve chips down to four: a 256-byte ROM, a 32-bit RAM, a 10-bit shift register (a form of RAM), and a 4-bit microprocessor. The microprocessor was the key to Intel's trimmed-down design. Instead of distributing the arithmetic and logic functions of the calculator among several hardwired ICs, all guided by many ROMs, Hoff proposed placing all those functions on a single IC—a chip that could be programmed to carry out almost any function. Busicom bought the idea (which other companies, notably General Electric, were also exploring at the time), and the 4004, the first microprocessor to reach the market, was born.

By today's standards, the 4004 was hopelessly primitive; microprocessors that can carry out millions of operations a second and address millions of bytes of memory are now commonplace. But the 4004 was a revolutionary development that changed modern electronics, making it possible to include data processing ability in hundreds of devices for the first time.

The 4004 can add two 4-bit numbers in about eleven millionths of a second and can multiply only by repeated addition. The chip contains a 4-bit adder, an accumulator (for keeping track of subtotals), and sixteen registers (for temporarily storing results). The two largest registers are the rectangular grids on the far right. The black bars along the edges are wires. Actual size: 0.110 × 0.150 inches.



1971

The First Erasable Programmable Read-Only Memory: The 1702

INTEL

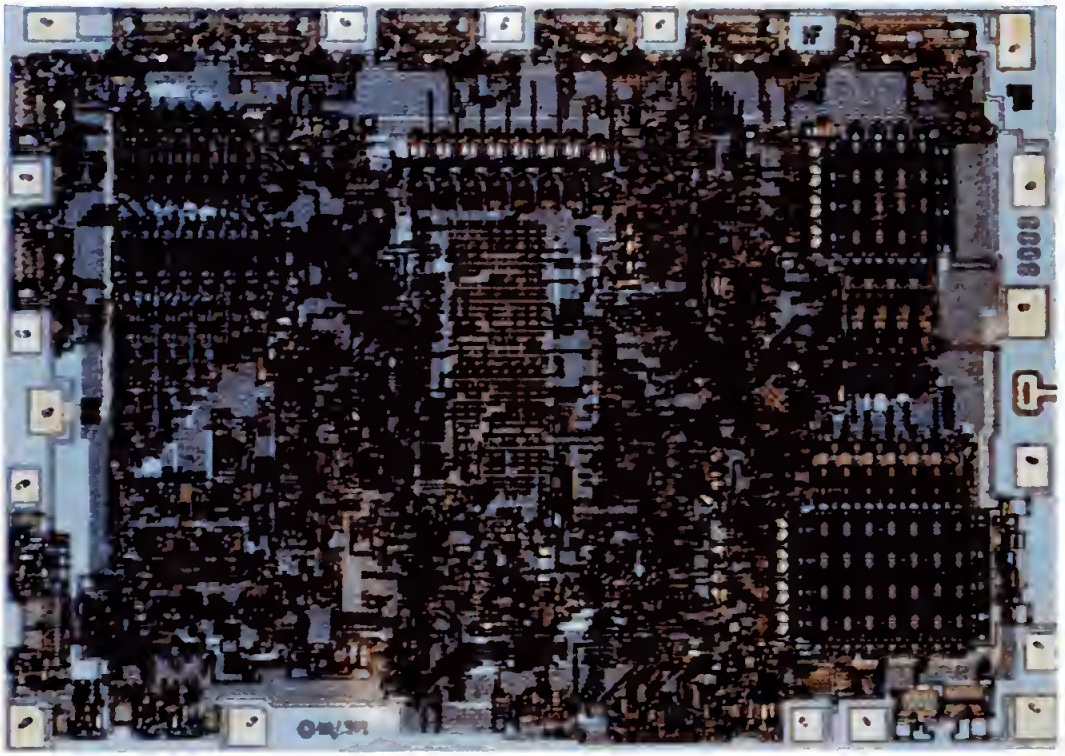
Intel's . . . contribution[s] to the development of the IC [include] . . . the erasable programmable read-only memory, or EPROM. It is a ROM with a special difference: its contents can be erased by ultraviolet light. An EPROM can thus be reprogrammed again and again, giving a single chip more lives than a cat, whereas the contents of an ordinary ROM are set for all time at the semiconductor factory and cannot be altered.

The key to the EPROM, which was invented by Dov Frohman, is a charge-storing capacitor embedded in the chip's memory cells; the capacitor is surrounded by an insulator, silicon dioxide, that turns into a modest electrical conductor when exposed to ultraviolet light for five to ten minutes, allowing the stored charges to drain away. An erased EPROM thus becomes a tabula rasa, easily reprogrammed by relatively simple electronic equipment. EPROMs are easy to recognize, because they come in packages with small quartz windows above the chips.

EPROMs are ideal tools for product development or for the manufacture of equipment with a total production run of a thousand or less. Since they can be erased and reset many times over, these chips are, in the long run, less expensive alternatives to ROMs, which must be junked and replaced if their instructions prove faulty, or if the developing product's specifications change. The invention of the EPROM helped Intel sell the microprocessor, which was invented at about the same time, by enabling the firm's customers to program their own memory chips instead of paying Intel to do it for them.

Since the development of the EPROM, other forms of programmable memory chips have proliferated like rabbits. The most notable types are programmable ROMs, or PROMs, which contain minuscule fuses that may be blown to burn in data; electrically erasable PROMs, or EEPROMs, which can be erased and reset electrically; and electrically alterable ROMs, or EAROMs, often termed read-mostly memories. With only limited applications, EAROMs can be read in as little as a millionth of a second but require much more time for data to be written in.

The 1702 stores up to 2K bits of data in two 1K grids in the center of the chip. A bit can read out of this chip in one millionth of a second. The irregular circuits around the grids are column and row decoders. Actual size: 0.147 × 0.161 inches.



1972

The First 8-bit Microprocessor: The 8008

INTEL

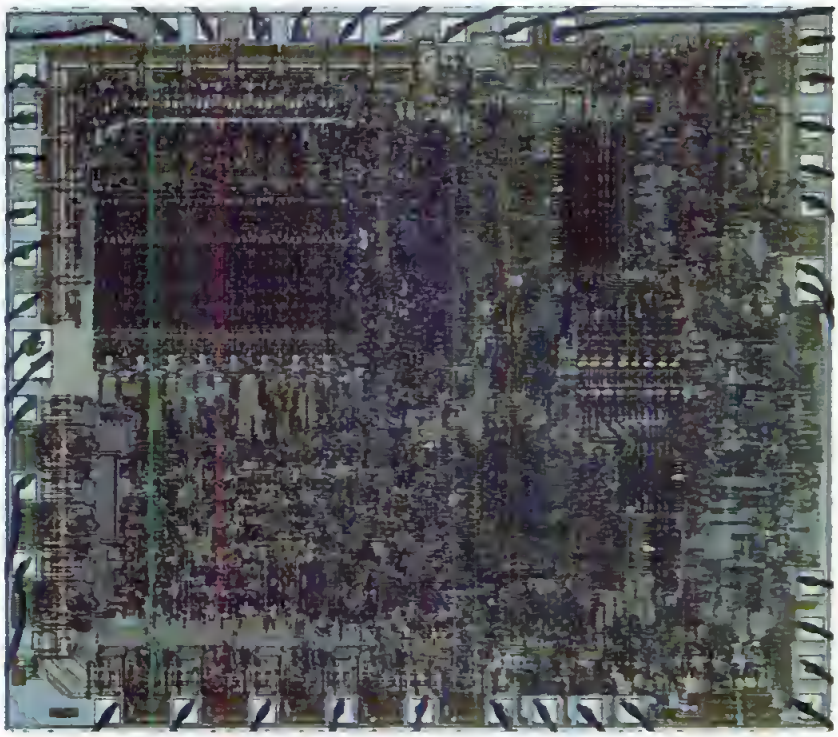
A few months after Busicom approached Intel to design the innards of a new programmable calculator, Computer Terminals Corporation (CTC), a Texas outfit, came by with a similar proposal. The Texas firm, now called Datapoint, asked Intel to design a set of ICs for an intelligent terminal (a monitor-equipped computer terminal with some computing power of its own) then on the drawing boards. Intel again suggested a microprocessor-based system, but the 4004 being developed for Busicom . . . wasn't powerful enough.

The 4004, being a 4-bit microprocessor, can handle data in chains of only four bits at a time. And it can generate only a very limited number of unique addresses for the data stored in memory—a mere 1,280 nibbles. Although quite adequate for most low-power applications, like running a handheld calculator, a 4-bit microprocessor is unable to meet the greater data processing requirements of an intelligent terminal. For this, an 8-bit chip is necessary.

So Intel came up with the 8008, an 8-bit microprocessor designed by Hal Feeney, Ted Hoff, Frederico Faggin, and Stan Mazor. With some 3,300 MOS transistors—a thousand more than the 4004 had—it could execute some 30,000 operations a second and address 16K bytes of memory. Nevertheless, the 8008 was rejected by CTC, chiefly because it was too slow and required many supporting chips. Intel subsequently offered the 8008 on the open market, where it was a great success.

It soon became obvious to Intel and other semiconductor makers that there was an almost limitless number of applications for microprocessors, and the race was on to create ever more powerful models. Because both the 4004 and the 8008 had been designed for specific machines, Intel was at first only dimly aware of the microprocessor's revolutionary potential. Eventually, however, it became abundantly clear that these extraordinary creations could not only enhance the power of calculators but also change the world.

The 8008 can execute a single operation, like the addition of two 8-bit numbers, in 12.5 millionths of a second. The chip multiplies by repeated addition, a time-consuming process. The grids on the right are registers; most of the rest of the chip is occupied by logic circuits. Actual size: 0.125 × 0.170 inches.



1974

The First General-Purpose Microprocessor: The 8-Bit 8080

INTEL

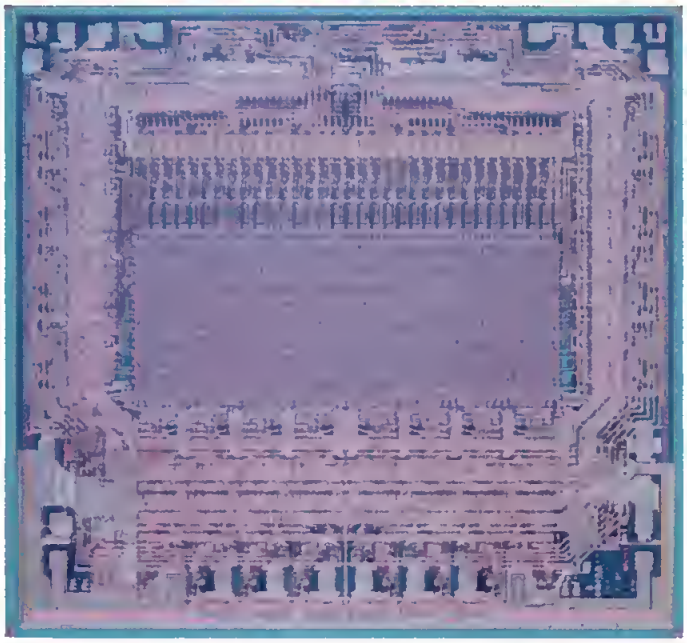
A turning point in the fast-moving history of the IC, the 8080 was the first real general-purpose microprocessor, and a great leap beyond the first and second microprocessors, the Intel 4004 . . . and 8008. . . . No other microprocessor, except perhaps the 4004, has surpassed the impact of the 8080, which brought computational ability to many machines for the first time and erased any doubts about the revolutionary significance of the microprocessor.

Because the 4004 and 8008 were both designed for specific applications—the former for a programmable calculator, the latter for an intelligent terminal—neither chip was especially well-suited to general-purpose computing. The 4004 wasn't adequate for anything faster or more powerful than a desk-top calculator, and the 8008 was too slow for most sophisticated electronic equipment and required a large assortment of supporting chips, which raised its total cost.

Enter the 8080, which was a great deal faster, more powerful, and more efficient than its precursors. With some 4,500 transistors, it can execute about 200,000 operations a second and address 64K bytes of memory. Its superior performance was to a large degree the result of using electron-doped MOS transistors instead of hole-doped ones. . . . (Electrons move three times as fast as holes through silicon.) The switch to electron-doped transistors was an important turning point in IC technology—one that greatly enhanced the performance of almost all ICs.

The 8080, which was designed by Masatoshi Shima, Ted Hoff, Stan Mazor, and Frederico Faggin, quickly became an industry standard, widely emulated—and sometimes plagiarized—by other firms. More than half a dozen companies make the 8080 under "second-source" licenses from Intel. (Second-sourcing is a widespread practice in the semiconductor industry, freeing IC buyers from monopolistic supply situations and bolstering a chip's overall position in the market.) It was innovative ICs like the one on the right that helped propel Intel from a slow start in 1969 to an industrial giant in 1981, with 20,000 employees and revenues of $788 million.

One of the most innovative and widely used of all microprocessors, the 8080 can add two 8-bit numbers in as little as 2.5 millionths of a second. Like the 4004 and 8008, this IC multiplies by repeated addition. The grids at the top are occupied by registers; most of the rest of the chip by logic circuits. Actual size: 0.165 × 0.191 inches.



1977

A Programmable Logic Chip: The PAL 16L8

MONOLITHIC MEMORIES INC.

Early logic chips contained a fixed number of logic gates and thus were said to be hardwired. At first, logic ICs were composed of only one or two gates, but the number rose each year, until hundreds and then thousands of gates were being placed on a single IC. Logic chips are the Boolean decision-makers of computers and other electronic equipment, but not all computers require precisely the same assortment of gates; a computer designed for scientific operations, for example, needs somewhat different internal circuitry from a word processor.

Since it's wasteful to use more logic chips than a machine really needs, or to use chips with thousands of gates that serve no practical purpose in a particular machine, engineers developed programmable logic chips such as the one on the right. One of the first was the Micromosaic; . . . it contained some two thousand transistors that could be hooked up to create almost any pattern of up to a hundred and fifty gates by altering the chip's aluminum interconnections in accordance with the customer's requirements.

Micromosaic and other customized chips greatly enhanced the versatility of ICs, but they were relatively expensive. Not only did the customer have to work closely with the chip-maker to design the right chip—and the two might be located thousands of miles apart—but the chip-maker had to modify the last stages of the fabrication process to produce the specific chip required. Then in 1977, engineers John Birkner and H.T. Chua (the latter had designed the 256-bit static RAM . . . invented a logic IC that can be bought off the shelf, so to speak, and programmed by the customer in his own plant.

Called PAL—an acronym for programmable array logic—the chip contains 2,048 tiny fuses. These fuses may be blown to create almost any configuration of up to two hundred and fifty AND, OR, and NOT gates. Blowing the fuses is a relatively simple procedure that opens some gates and closes others. Properly programmed, PAL can replace a dozen or more hard-wired chips. Incidentally, a logic chip is not the same thing as a microprocessor. The latter is a self-contained calculating engine, whereas the former can perform only a limited series of operations and is often controlled by a microprocessor.

The PAL 16L8's logic gates are arrayed in a central grid that resembles a matrix of memory cells. The bright hues of this photo are the result of colored lights shone on the chip. Actual size: 0.133 × 0.138 inches.

Editor's note: In the next issue of PC, *the final installment of* An Illustrated History of the Chip *will bring the development of the IC up to the present—and beyond.* ■

When One PC Is Not Enough

When your workload outgrows one PC, you can buy another or invest in networking. Better yet, plug in the PC GT, a circuit board that converts your PC into a multiuser system.

It's true: One PC can make nearly any job easier. Soon you wonder how you ever got along without it. But all too quickly your computer work becomes more than one machine can handle.

You my be tempted to buy another PC, but adding another may create more problems than it solves. Networking may solve some of the problems, but it's expensive, and a high-performance network probably exceeds the needs of a small office. Another alternative is multitasking, where the software allows two or more users to share one computer.

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Note: PC GT will be available in limited quantities at the end of March.

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But a third option—adding more simultaneous users to each machine—has recently emerged, courtesy of Sierra Data Sciences' PC GT.

The PC GT is a circuit board that plugs into an IBM PC expansion slot and converts the single-user PC into a two- or three-user workhorse. One or two "dumb" terminals (which have no capabilities on their own) can be plugged directly into the PC GT card, and with Sierra Data's new MX-DOS operating system, which is required to operate PC GT. The terminals will act exactly like additional PCs. They become "virtual computers," which means they are separate entities as far as individual users are concerned, but are still part of one machine.

The virtual computers in the PC GT system can share peripherals (such as printers and modems) and access the same databases in the host PC's disk drives, but that's not all. Each of the terminals and the PC attached to it can also simultaneously run different programs. In technical terms, the PC GT converts one PC into a multiuser, multitasking computer system. In practical terms this means that your PC can handle more users without adding more computers.

Although the PC GT shares many features with networked computer systems, the differences between the two are more important than the similarities. The PC GT system is less complex to install, understand, and use, and getting it running is much less expensive. But before I take a closer look at this, I'll examine some of the other options.

Growing Pains

When the tasks you have to accomplish on your PC outstrip the capabilities of a

single machine, there may be a temptation simply to buy another PC. But these two machines are completely ignorant of each other, so that the duplicated data must be updated on each machine, and data can never be shared. This setup is also expensive.

A better solution is to allow the two computers to talk to each other or share a common set of files, which is how mainframe and most minicomputer systems work. Each user has access to the same massive database, and when the main database is changed by one user anywhere in the system, the change is reflected on all the other computers.

One way to establish this arrangement among personal computers is networking. With a single cable, you can tie together all the computers and peripherals so every machine can talk to every other one, and a single database can be shared by the whole group.

It sounds like a perfect solution, but the networking option introduces a penalty in terms of cost and complexity. Not only does a network system require that each user has a complete computer, but each computer needs an expensive network interface (usually a PC expansion card) that makes the computer compatible with the networking system. Then each operator must learn an entire new range of commands to access the network and send and receive information on it.

Networking is also expensive. Furthermore, it is an unwieldy alternative for a small business or professional operation. A medical office or a small retail store, for example, would only require a simple but powerful system that can inexpensively accommodate several users working on different tasks simultaneously—something that falls between a PC and a PC network. This type of setup is called a multitasking system.

Multitasking Computers

Several software packages are available for the IBM PC that allow multitasking, which permits your computer to work on two jobs at the same time. Many word processors, like *WordStar*, allow you to work on one document while printing another. Multitasking operating systems, like Concurrent CP/M, let you run two different programs at the same time—or seemingly so.

However, most software packages can

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handle only one job at a time. Because the computer's microprocessor can think so fast, it can shift between two jobs more quickly than the human mind can perceive, so it seems as if two programs are actually running simultaneously.

The switching between jobs is not always invisible. With slower microprocessors, it takes a while for the computer to get part of one job out of the way before shifting to another one. Some programs flash a message on the screen to tell you to wait, because they are otherwise occupied. Others don't even let you know—they just balk at your commands.

Although the PC's 8088 microprocessor works quickly enough for a single user, it slows down when used by more than one person at a time. It just doesn't have enough free time to divide up among users. The 8088 chip is just not fast enough to handle multiple simultaneous users. With more than two users, someone will invariably have to wait. Multitasking by itself is not enough.

The PC GT (and similar products) will offer the best solution to the single computer overload problem. Previously, the solution has been to forego the PC and invest in a multiuser, multitasking minicomputer or micro system.

Two Computers On Board

In essence, the PC GT puts another computer inside your PC—one that's faster and more powerful than the PC itself. A single PC GT expansion card can be shared by two separate users, and the IBM PC in which it is installed can be used by a third person—all at the same time. Each of the PC GT's users is assigned a block of RAM memory, located on the GT card, to handle his programs. The manufacturer wrote its own operating system to accommodate multiusers.

In standard configuration, each user gets 128K RAM, although space is provided on the GT to expand the memory available to each user up to 512K using 256K-bit memory chips. Since the users of the PC GT card do not have access to the RAM of the host computer, the full RAM capacity of the host PC can be used by its operator.

That megabyte of memory and the other chips on the PC GT use a lot of power, as you might imagine. According to Sierra Data, a single IBM PC is capable of running two or three PC GT cards (for up to

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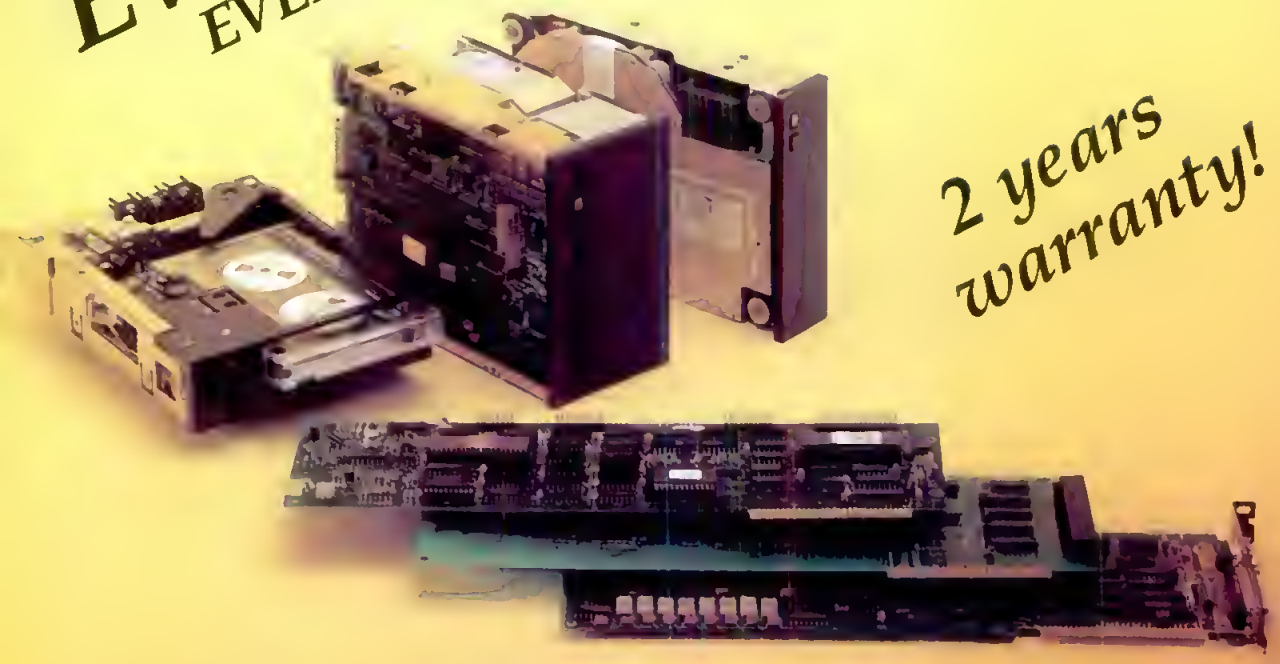

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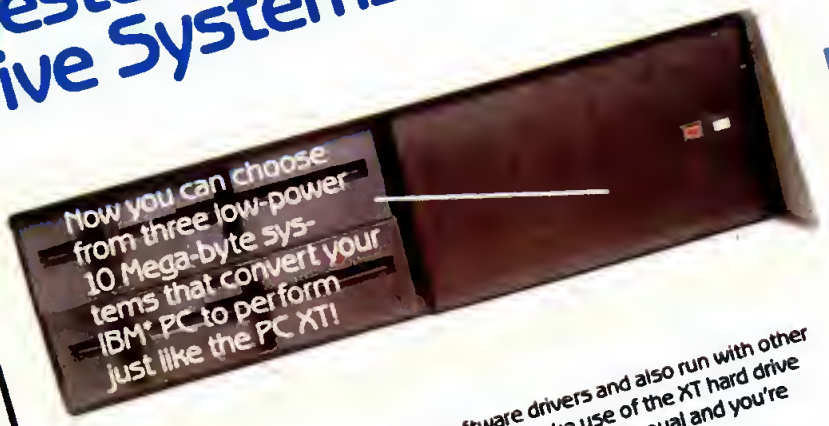

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This System is equipped with the SandStar™ Multi-function card. In addition to the Hard Disc Controller Module, you can add up to three other SandStar™ Modules while using only **one** card slot. The following modules are available: Serial Port, Parallel Port, Clock Calendar, Game Adaptor, 5451 Host Adaptor and Prototyping Module

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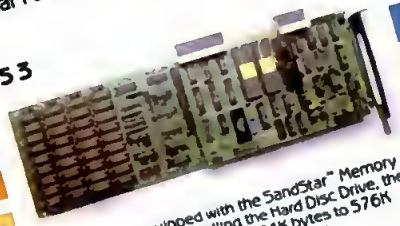
This System is equipped with the SandStar™ Floppy Drive Controller Card. The Card can control, in addition to the Hard Disc Drive, two floppy drives mounted inside your PC and optionally two additional 5¼" or 8" drives mounted externally. This leaves three system slots for other expansion boards

WS 3



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seven users) without a power problem. More than three cards may strain the host PC, depending on what else is in its remaining expansion slots.

Although the GT card uses only one microprocessor, it looks and acts like two separate computers. Both of these virtual computers share the peripherals attached to the host PC, and each acts exactly like an IBM PC directly attached to those same peripherals.

After the system is initialized by booting up the PC and running the PC GT program (which can be an Autoexec.Bat file), each user will see the familiar A> prompt on the screen, and he can load and run programs exactly as if he had a single PC under his control. The only waiting time involved is when more than one user needs access to any of the peripherals or disk drives at the same time.

All communications with the drives and peripherals are handled by the PC's 8088 microprocessor, which can still only do one thing at a time. If two users ask for the same drive simultaneously, the requests are queued—one is given access while the other waits in line. The PC GT software allows different priorities to be assigned to different users so that when the boss wants to use the computer, he can instantly demand its attention. Sierra Data has also built into the PC GT a cache system that temporarily stores the most frequently used sectors from the disk drive so the GT does not have to keep referring back to the disk itself.

Once a program has been loaded into the PC GT's memory, there's no more waiting. In fact, each of the two virtual computers on the GT card will run *faster* than the host PC.

Instead of using the PC's 8088 microprocessor, Sierra Data chose the closely related, though more advanced, 80186. The difference between the two processors is significant. Even though IBM calls the PC a 16-bit computer, the 8088 has only eight connector pins for getting signals in and out of the chip itself; hence, it functions like an 8-bit processor when it must communicate with the outside world. The 80186 is a full 16-bit microprocessor. It manipulates data 16 bits at a time inside and has 16 pins for communicating. This means that it can do many operations twice as fast as the 8088.

Extra Speed

Sierra Data has souped up the PC GT even further by operating its 16-bit microprocessor at a clock frequency of 6 MHz, compared with the PC's 4.77 MHz, for an

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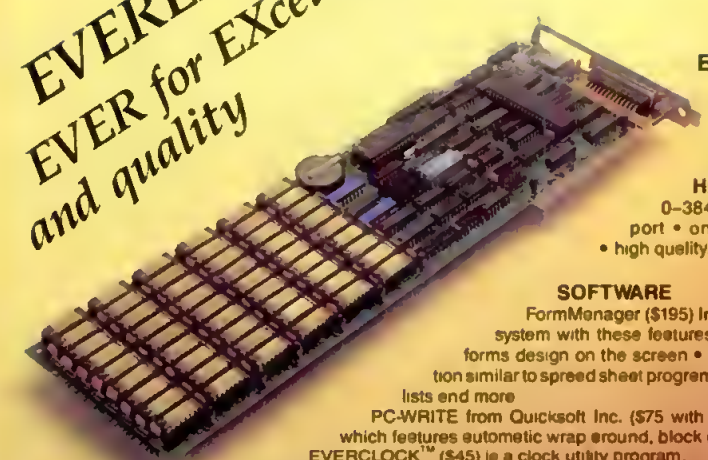

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additional 20 percent speed advantage.

Of course, the virtual computers on the PC GT card are not complete. They lack a means for human beings to talk to and listen to them, and there's no monitor screen or keyboard included. But all that's necessary to get at the PC GT's capabilities is an ordinary dumb terminal (according to the Sierra Data, the GT functions well with a $395 terminal). Two RS-232C connectors on the GT board are configured to plug directly into nearly any standard terminal. The serial ports operate at speeds up to 19.2 kilobaud, which is fast enough to change a terminal's screen in a fraction of a second. Part of the software that runs the GT converts the PC memory map into the proper control sequences to display data on the terminal's monitor. When part of a display changes, rather than the whole screen being refreshed, the PC GT only changes the parts that are different, which speeds up the system even further.

Although the connection hardware for the serial ports is not the standard DB25 connectors, Sierra Data does provide short cables that will adapt the ports to standard connectors. Installation software (which only needs to be run once, when the GT system is installed) sets up the GT to use the proper control sequences to talk to most terminals merely by choosing the brand and model of the terminal you have from its menu. If your terminal is not listed on the menu, installation is possible (but more tedious) by keying in the necessary control codes.

The PC GT card also provides a parallel port, but it will not substitute for a PC LPT port, and it cannot directly control a parallel printer. Sierra Data is developing a hard disk unit to plug in there.

The PC GT system makes financial sense for most small business users. After adding in all the extras, including a pair of cheap terminals, the MX-DOS operating system and the PC GT itself, total cost amounts to a little more than $1,000 per user to get started with a minimal system—about $3,000 dollars less *per user* than the cost of a typical networked system. Further, rather than the exotic technology and expensive coaxial cables required with a network, a PC GT system can be connected with a three-wire cable. For modest length runs, even standard (and cheap) telephone cable will work.

The PC GT system is less complicated than even the simplest network, and it's easier to use. If you know how to run a PC, you can run any terminal in the PC GT system. They work exactly the same way. ■

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CIRCLE 167 ON READER SERVICE CARD

Taking The PC to the Cleaners

From huge institutional laundry plants to your friendly neighborhood dry cleaner, laundries are using personal computers to take a byte out of grime.

No doubt you've heard about the PC in the lawyer's office, about the doctor's database of patients' files, and about the writer at the word processor. Then there's the PC down on the farm, the computer in the classroom, and the micro as a family member. What you may not know, however, is that PC is turning up in an even more unlikely place: the laundry.

Laundries and dry cleaners process millions of items each year. While for years the big guys in the industry have had mainframes and data processing departments to handle their invoices and keep track of inventory, the small cleaning businesses that you and I are more familiar with as well as the mid-sized commercial laundries have recently begun buying PCs and XTs. Turnkey hardware/software packages are now being designed around these computers to help meet the specific needs of laundries.

"When we speak about laundries, we have to get our terms straight," said Bill Cashin of the Florida-based Textile Rental Services Association, a trade organization that represents thousands of laundries. "Laundries fall into three categories: first, textile rental companies, which rent, clean, and repair uniforms or linens for companies and institutions such as hospitals; second, in-house plants that do their own laundry and own their own uniforms and linens; third, commercial laundries that handle laundry for individuals and companies, but do not own the garments or linens."

In addition, laundries in any of these categories can include dry cleaning departments, and there are, of course, businesses that specialize in dry cleaning. These businesses may range in size from small, individually owned stores to giant chains with central plants.

Cleaning Up

Micros are helping out in laundries of all types, and their use has greatly enhanced both customer satisfaction and company profits. Before computers became available to mid-sized laundries, which bring in $5,000 to $50,000 per week, controlling day-to-day business was one big headache. For instance, the International Fabricare Institute has reported that theft by employees accounts for at least 3 percent of gross sales receipts. Improperly priced services and failure to charge for special services (such as handling suede, silk, or similar materials), lost tickets, and inaccurate inventory all eat into profits. Furthermore, keeping

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track of all these problems at once can be very difficult to do manually.

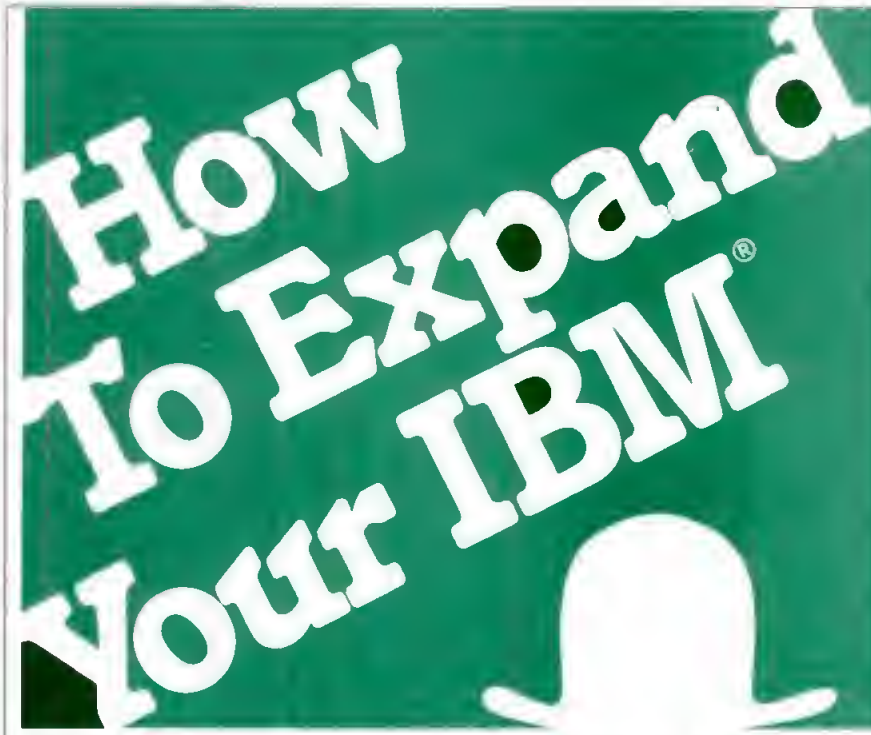
According to Mervyn Sluizer, technical director of the Institute of Industrial Laundries, a trade association in Elkins Park, Pennsylvania, many companies have developed turnkey systems for laundries and dry cleaners. "Some of these manufacturers were originally laundry owners themselves; they spent a lot of time and money creating software for their own needs, and now they have gone public with their products. Others are computer companies looking for new markets."

One such computer company, National Micro-Computer Software of Reading, Pennsylvania, has developed an XT-based system for the dry cleaning industry. It rents the hardware with an option to purchase. Andrew Tirpok, Jr., of Tirpok Cleaners in New Jersey, purchased one of National's systems over a year ago. He uses it for both wholesale and retail laundry and dry cleaning operations. "The main benefit is inventory control," Tirpok said. "Our six stores handle dry cleaning, laundry, and even shoe repair. We are in a rural-suburban area, and we appeal to everyone's needs. We have four or five big commercial accounts—hotels, factories, car service centers—and hundreds of charge accounts to keep up with. The system lists the articles in each store, and we can check that against the actual contents of the stores when we visit them.

"Daily sales, cash, and charge reports are generated according to seven categories. Right now, when a customer comes into a store, we manually make out an invoice, which is sent to the plant and keyed into the system there. Every invoice is on record quickly," Tirpok said.

Tirpok is especially enthusiastic about his order for a new wand bar-coding device called Liberty Listers. It is similar to the system McDonald's uses to ring up sales. An employee will touch a bar code labelled with the name of a specific item, such as "blouse, silk." The price will be automatically recorded and fed over a modem to the micro at the central plant.

In the Philadelphia area, Herb Markman is known as Mr. Laundry. As the owner of Markman Associates, he has been dry cleaning Philadelphia's clothes for years. Markman had already developed a hardware/software package for dry cleaners based on the Intel 8080 microprocessor, and he recently added an IBM PC-



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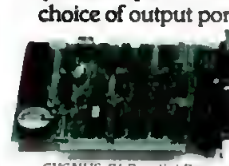

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based system to his line. This new vertical software system, for mid-sized dry cleaners, is being distributed beginning this spring by the Neighborhood Cleaners Association (NCA), a seven-state trade organization. NCA has 3,500 members, 95 percent of them individual stores rather than chains. Markman called it "a multiuser, multiterminal system run on a PC." It will have a custom RCA membrane keyboard, a Zenith monitor, and an Okidata printer with graphics capability.

"The dry cleaner has two main problems: treating special materials like silk and suede, and theft," Markman said. "The 126-key keyboard has 11 colors and a key for practically every variation of item. The computer also takes bar code readings and prints out missing ticket numbers. Inventory is taken with a remote wand that reads bar codes on tickets against the garment tags. It's very fast because it uses a BASIC compiler. We end up with response times that get the customer in and out quickly."

Markman's PC systems sell for $10,000 and $15,000. "The larger one is a two-station system to handle the point-of-sale at the counters. An added specialty board makes this a multiuser PC. A marketing advantage is that you can run any PC software on the computer in addition to our software. There are 35,000 dry cleaners in the United States—quite a market!" said Markman of his prospects. Bill Dietz, president of the NCA, said that he expects Markman's new system to become an industry standard.

A third turnkey system is produced by Leasetex of Branford, Connecticut. Originally configured to run on an IBM System 32, it is now geared for an XT. The cost of the software system, support, and training, without the computer, is about $6,000. The program is designed for the industrial laundry user, such as textile rental firms with rental volume of between $5,000 and $95,000 per week. Another hardware/software package comes from American Electronics Laboratories, Inc. (AEL), of Lansdale, Pennsylvania. The company has been in the laundry business for some time, manufacturing machines for all laundry processes. Its new system, like Leasetex's, is designed specifically for the textile rental business.

AEL, along with firms like Braun and Pellegrin-Milnor, has been making laundry machines with built-in microprocessors for years. Microprocessor controls have recently reached new heights of sophistication, however. They can automatically correct detergent or chemical

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mixes, refuse overweight loads, or shunt loads from one conveyor belt to another.

Wheel-o-matic by AEL is a laundry machine microprocessor control that can withstand the heat and humidity in laundry plants. It gives alphanumeric readouts of 16 possible preprogrammed wash formulas. The microprocessor interfaces with an XT, and it can provide information on wash loads, turnaround time, and mixes.

Laundry of the Future

Pellegrin-Milnor, a laundry machine company in Kenner, Louisiana, plans to introduce the laundry-of-the-future at CLEAN '85, the industry trade show, to be held in New Orleans. Mark Doyle, a project engineer at the company, explained, "This is a revolutionary washer-dryer we've just started installing in plants. At the CLEAN '85 fair we're going to give each laundry machine its own microprocessor. They will all talk to each other through a circuit, and then to a microcomputer." Doyle considers the new equipment a real breakthrough for the industry. "Our new microprocessor allows you to program every step of the machine's wash function. The serial board is in the infant stage, but we plan to interface it with a micro like the PC-XT."

> The microcomputer that runs the laundry will monitor the entire process, record the data, and keep an accounting of the processor's functions.

Doyle explained how the new wonder washer will work: "Let's say a customer has a load of towels for a hospital or hotel." An employee will punch in the client's name and the item on the keyboard. The towels will be tracked all through the laundry. Conveyors will take the towels to the right dryers for the right amount of time, and then to the ironer and folding table. All the machines are preprogrammed for the correct mix of detergent and the necessary time.

"The microcomputer that runs the laundry will monitor the entire process, record all the data on the number of loads and temperatures, and keep an accounting of the processor's functions," Doyle said. "The microprocessors are already sophisticated enough to control the type of cycle and mix, but the personal computer would monitor almost everything else. You could ask the PC where, for example, batch number two is right now, or poll all the microprocessors for information."

As in every business, there are laundry do-it-yourselfers who have bought a database system and a PC to write their own software for the business end of laundry and dry cleaning operations. These entrepreneurs attended CLEAN '83 in Chicago and hawked their wares alongside vendors of microcomputers and of general-purpose business software. *Laundry News* reports that industry experts expect all aspects of the business—from the largest institutional companies to the smallest neighborhood store—to come under computer control and monitoring within the next few years. The market is enormous. It looks like the computerized laundry industry is going to clean up. ■

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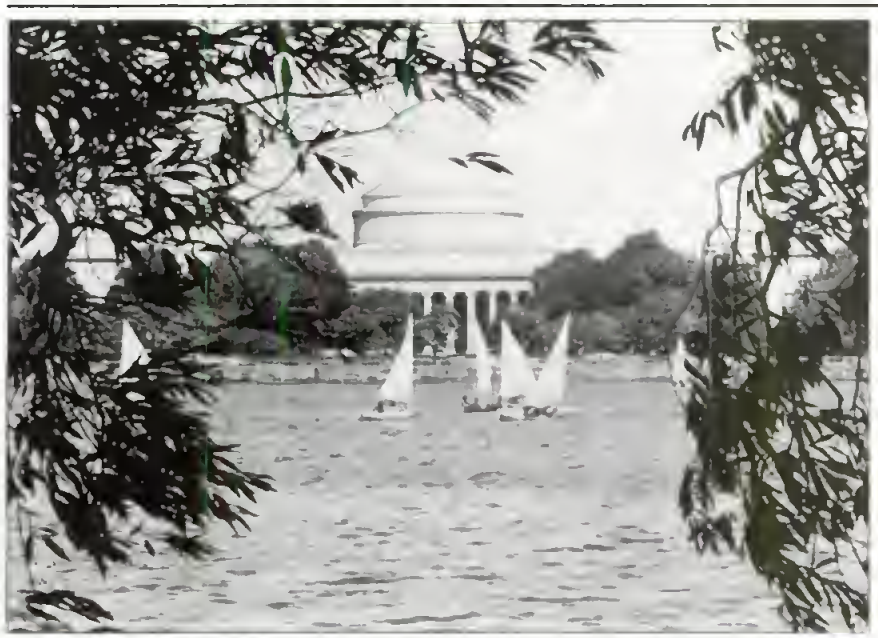
MIT Goes On The 5-Year Plan

Will personal computers help make better bridge designers? The Massachusetts Institute of Technology is committing millions of dollars to finding out.



A view of the Great Dome of the Massachusetts Institute of Technology from across the Charles River.

Photo by Calvin Campbell, courtesy of MIT

If it soon becomes possible for a Massachusetts Institute of Technology undergraduate to sit by himself in his dorm room, design a bridge on a personal computer, test it for stress factors, network it to his professor's personal computer, and receive an evaluation on his screen, will he be more of an obsessive, socially awkward hacker than today's MIT student stereotype?

And if he is exceptionally skilled, could he gain access to the bridge designs of his fellow students by electronically invading his professor's disk? And if he could, would he?

MIT faculty members are concerned about such issues this fall as the university embarks on Project Athena, the most extensive, and probably the most expensive ($70 million) effort ever to integrate personal computers into the curriculum. "We have to remember that we are still

dealing with late adolescents," observes a civil engineering professor. "If we change the way they learn, the way that the university operates, we are changing the environment here. Our goal is to make the learning process better and more productive. But we don't want to produce a crop of social misfits."

Project Athena, named after the Greek goddess of wisdom, is big potatoes even for MIT, with its longstanding position of leadership in technological innovation. Norbet Wiener did his pioneer work in cybernetics here. Radar was perfected in barracks-like buildings, still standing between modern concrete structures. Jay W. Forrester developed magnetic core memories, the brains of the computer revolution, at MIT. And pioneering work was done here in sub-atomic particles, genetics, laser disks, and numerical control of machine tools (the key to robotics). These are a few of the more visible accomplishments at what is one of the world's leading research universities.

Some money will go to psychologists and sociologists to study the effects, if any, of extensive computer isolation on students.

How does a major league university gear up for a pioneering effort to put much of its curriculum on computers? It goes to the major league computer companies and asks: "Do you guys want to get in on this?"

The answer is an unequivocal "Yes." IBM and Digital Equipment Corporation, the world's two largest computer manufacturers, will provide $50 million in equipment, software, service, maintenance, support, research grants, and on-campus experts during the 5 years of Project Athena.

MIT is seeking another $20 million in grants to provide funds for faculty research, released time from teaching, and assistants. Some of this money will go to psychologists and sociologists to study the effects, if any, of extensive computer isolation on students.

It may be difficult to measure the specific detrimental effects of computer isolation, for MIT's 9,500 students already carry a much heavier load of homework and

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classwork than most American college students. MIT officials are somewhat reluctant to discuss the possible negative effects of Athena, in part because they are weary of the stereotype of the MIT student as grind and hermitlike hacker; in part because they don't know what the effects of increased computer influence in the curriculum might be; but chiefly because they anticipate that Project Athena's beneficial effects on the educational process will far outweigh any liabilities. Much of the faculty, especially in the engineering department, feels that computer-enhanced education is the wave of the future and that MIT would be negligent if it did not attempt to lead the way.

Learning Faster

The technology is available to use computers in teaching to a much greater extent. If the MIT program enables students to learn faster and better, then they can probably absorb more knowledge than they currently take away from a 4-year undergraduate program. Project Athena will concentrate on undergraduate education throughout all five of MIT's schools, though its heaviest use is expected to be in engineering and science and in such fields as economics that tend to be heavy in mathematics.

MIT, of course, already has an immense computer capacity. However, until now, its mainframes and computer centers have been used chiefly for research and administrative functions. Some of the big mainframes can interact with each other and with several screens, and can produce three-dimensional drawings of structures and stress problems and crystallography. Such graphics are enormously computation-intensive and require huge memories and high speeds. It is only recently that personal computer memories have developed to a point where an effort like Project Athena, with large numbers of students using small computers for learning purposes, has become feasible.

"An important point to remember is that this is an experiment," notes Jerry Wilson, dean of the MIT school of engineering. "We believe we can help students learn by using personal computers and computer graphics in new ways, but nobody is sure exactly how. Our experience suggests that computers can aid the teaching of difficult concepts, give new life to laboratory experiments, help in developing the skills, knowledge, and insights needed for design problems, and, especially, help nurture that elusive talent we call intuition." *(continued)*

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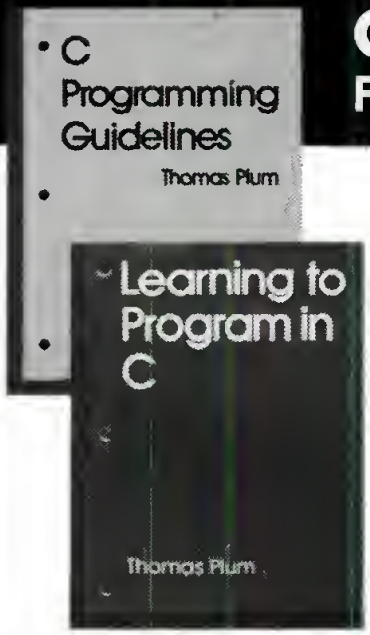

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5-YEAR PLAN

Dean Wilson, 44, is a big man, with the appearance of a heavyset Irish cop. He is an expert on the generation and transmission of electrical power and has worked as a consultant to GE, Westinghouse, Boston Edison, Consolidated Edison, the American Electric Power Service Corporation, Ratheon, and Electric Boat.

Project Athena is pretty much his baby. It was his idea to expand its scope from the engineering school (the flagship of MIT) to the four other undergraduate schools: humanities and social science, management, architecture and planning, and science.

During the Athena planning process last spring, Dean Wilson invited written suggestions from faculty members in all the schools to determine the amount of enthusiasm and imagination existing on campus for the project. "If I'm going to charge up the mountain with this and plant the flag," he confided to an aide, "I want to be sure the faculty is behind me."

He sees Athena as a complex project with yet unknown boundaries. "Just having computers and graphics isn't the key," he says. "If it were, we could put all the material we have on videotape and give every student a television set. The key is for the student to interact directly with the graphics, to change a component to see what happens, and to play 'what if. . . .' That direct and personal interaction makes this project exciting."

Dean Wilson expects that Athena may produce textbooks with floppy disks inside the cover. And he sees computers serving as expert aids for tutoring. Such tutoring could guide the student's progress according to his or her interests and abilities, and encourage experimentation.

Computer Bilingualism

The professors involved with Project Athena repeatedly use the buzzword *coherence*. They want the IBM and DEC personal computers to be able to talk with each other and to interact.

Like most computer users, they are disturbed that software developed for use on one machine cannot be used on another, (and often not even on a different model by the same manufacturer). They are annoyed that manufacturers cannot even agree on a standard size for diskettes. One of Athena's major goals is to establish some standardization of software and hardware.

Some of the expert student hackers at MIT have developed a quasi-illegal process for adapting software designed for one machine for use on another. The faculty intends to explore the techniques involved.

> It's hard enough for students to learn one language. How do you teach them both? But we're going to try.

"Right now IBM and DEC don't talk to each other," explains Eric Johnson, assistant dean of engineering. "We want to eliminate that. MIT provides the environment in which both can work."

"The students ask us now: 'what kind of computer should we buy?' And we can't tell them. By the end of the project, we should be able to give them an answer."

The personal computers used will have a UNIX-based operating system. Students will be required to learn both FORTRAN and LISP. The faculty believes that FORTRAN is the best language for numerical computation and LISP is best for scientific matters, symbolic computation, and artificial intelligence exploration. It is expected that Athena will result in the creation of compilers that will permit users of the two languages to talk to each other and use each language for its strengths.

"I don't know if we're setting unrealistic goals," cautions Professor Steve Ler-

man. "It's hard enough for students to learn one language. How do you teach them both? But we're going to try. It's our attempt at bilingualism."

The Stages of the Program

Initially, IBM personal computers will be used in programs for all first-year students, and by faculty and majors in the schools of science, architecture and planning, management, and humanities and social sciences. Faculty members, sophomores, juniors, and seniors, in the Engineering school will use DEC hardware and software during Phase I. Students will also have access via computer to information on how to register for classes, descriptions of classes and requirements, and student evaluations of faculty members. The professors and each dormitory will have a hard-copy laser printer.

During Phase I (the first 2 years), IBM will provide the university with 500 PCs or PC-XTs (or whatever the top-of-the-line state-of-the-art personal computer may be in January, when they are scheduled for delivery). During Phase II (the final 3 years), IBM will provide 500 of the hottest personal computers it is building in 1985 and 1986. It is assumed that the Phase II machines will be strongly affected—in functional ability—by the Phase I experience. DEC's contribution to Phase I will be a mix of more than 300 alphanumeric display terminals, personal computers, and advanced graphic workstations, as well as 63 VAX 11/750 and 11/730 minicomputers. In Phase II, DEC will provide the Athena Project with about 1,600 advanced personal computers.

Both IBM and DEC will have at least five representatives, each stationed at MIT throughout the 5-year project. They will work with faculty and students to blend computers and graphics into the educational process.

Professor Lerman has immense optimism about Athena. "When I was a student here in the early 60s, everyone carried a slide rule on his belt," he recalls. "Then a few years later, the pocket calcu-

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lator replaced them. A lot of guys still keep their expensive slide rule in the attic, hoping they will have some antique value some day. The personal computer will take the place of the pocket calculator. Everyone will have one, at least every engineering student in the future. And they will be indispensable."

Essentially, engineers design things. And that's what they learn to do in college. However, teaching a kid in his late teens or early twenties to design well is difficult. There seems to be an element of genetic gift in the ability to do design well. Some students pick it up quickly. Others have an inordinately difficult time visualizing and thinking in three dimensions. Traditionally, a professor looks over the shoulder of a student at a drawing board and tells him: "That's wrong. Try it again and do it this way." Or: "Watch how I do it." The student tries until he gets it right. Obviously, this method is tremendously time-consuming, especially in the case of students who lack a natural flair for design. Also, all professors are not equally good at this type of teaching. Some of the best designers have difficulty imparting their skills to students.

Project Athena will develop graphics to help students visualize, in two and three dimensions, the computations involved in bridge stress, or fluid flow, or heat transfer, or crystallography analyses. "Graphics is really computation-intensive," explains Professor Lerman. "And it's expensive. A good graphics memo can cost as much as $10,000. Just one picture can be 1,000 dots by 1,000 dots with 8 shadings. That's a million dots just for one small piece of the lesson."

MIT students will not, as at Carnegie-Mellon University in Pittsburgh, be given their own personal computers during the first stage of Athena (though many already own them). Computer centers (electronic villages, as some professors refer to them) will be established throughout the MIT campus for faculty-student experimentation early in 1984. Here, professors will observe student efforts to learn with experimental software as it is developed.

The personal computers will move into the dormitories during the second stage of Athena. Each dorm, and possibly individual dorm rooms, will have a port into which the personal computers and display terminals can be plugged. These regional clusters of machines will be connected—by wire—to scores of huge mainframe computers, with an overall "spine" network. The mainframes, storage devices, and printers will serve the classroom and homework needs of students throughout the university. MIT experts will work with the IBM and DEC representatives on campus to develop the necessary interface technology.

> Some professors have spent the summer enrolled in computer courses.

This technological feat will provide wide capabilities for networking among students and faculty and their machines. Connecting lines will transmit data at the rate of about one million characters per second. Further, the new generation of personal computers supplied by IBM and DEC 2 and 3 years from now is expected to have pixel capabilities far beyond the machines that arrive in early 1984.

The Dancing Penguin Technique

The chief initial computer activity in areas outside of engineering will come in linguistics, psychology, music, political science, economics, biology, chemistry, physics, astronomy, mathematics, and the teaching of languages. Some professors in these fields have spent the summer enrolled in computer courses at MIT so that they will be prepared for the arrival of the PCs or PC-XTs or souped-up XTs in January.

How will Athena help in these fields? Suppose a language professor decides that conversational French could best be taught from a display terminal showing a dancing penguin in a beret, asking through the PC speaker in perfect French (audio), "Où sont les neiges d'antan?" (Where are the snows of yesteryear?). "The problem with teaching languages," explains Dean Hanham, "is that you have to have small classes to make it work. But for economic reasons, they are usually not nearly small enough for everyone to engage in the conversation that is needed. The best language teachers have their students play roles. They try to develop the way people think and talk. This has nothing to do with the teaching of formal French that I was subjected to."

At present the video capacity of most existing personal computers is insufficient for the dancing, talking penguin, and software for such a program does not exist. The faculty expects that the Phase II contributions, in the third year of the effort, will include some personal computers with laser disk capacity. These could provide almost infinite capacity for pictures, sound and data storage. The French-speaking penguin will indeed be technically feasible. So will a sound video of a professor's lectures, and computer programs that can interrupt a kid drawing a bridge if he's about to commit a common mistake. The bridge drawing could disappear from the screen for a few seconds and be replaced by the professor's face, growling: "Careful! Those left supports would collapse under a two-deck load."

The possibilities for a quicker grasp of complex material, in many fields, are vast. In economics, the faculty will attempt to develop adjustable models of national and international economies that will allow students to pose questions such as, "What would be the inflationary effect of a one-third increase in the federal deficit?" Students will be able to punch in the increased inflationary spiral caused by the higher federal debt and observe whether it plunges the world into a depression or boom.

Similar game theory instruction is envisioned for political science classes. "Sup-

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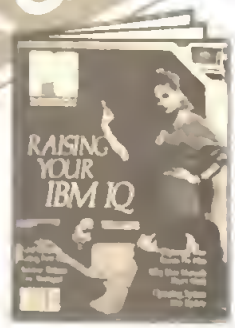

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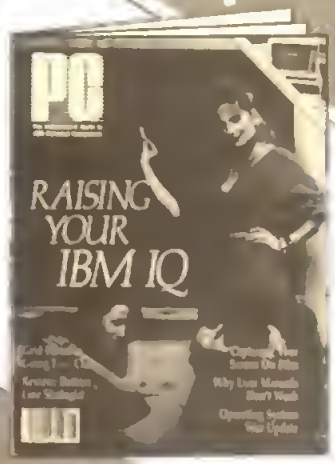

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pose that you know the world's on-hand oil supply," suggests Harold John Hanham, dean of humanities and social science. "And suddenly the Suez Canal and the Persian Gulf are both blocked. What are the options? What is the immediate effect?"

Security Problems

Security will be a problem. Buildings at MIT are open much longer than in most universities. And the locks on faculty office doors are typical office door locks—no high-tech innovations here. One proposed solution may be to have the computers polled—by the spine system—every fraction of a second. When one is unplugged, the campus police would immediately be notified by a Mother computer.

Another concern of the faculty is that MIT students are so skilled, so curious and innovative, that they may attempt to dismantle and rewire the personal computers just to see how they operate. So far, the professors have not developed a solution to this problem, other than a vague hope that stem pleading by the faculty will prevent dismantling of the machines.

Another problem: "The temptation for some kids to 'hack' the system will be immense," observes one professor. "They probably will attempt to access each other's homework, not so much because they want to copy it. Those able to hack the system will be our best kids, but they'll do it just for the challenge, the hell of it."

A Substitute for Teaching?

Professors repeatedly assure visitors that they will not permit the computers to become a substitute for good teaching. "My teaching is not going to be changed," said Henry Farber, associate professor of economics, who has an IBM PC of his own at home. "I'm not going to be handing out floppy disks. But the networking is going to be an important part of this. For example, I could set hours that I'm going to be available on the machine and collect assignments on it."

Joel Moses, head of the electrical engineering and computer science department, explains, "This is an experiment. I want to emphasize that. We will explore whether there is a trade-off in terms of intellectual development between using material on computers and seeing faculty, perhaps some sort of trade-off like the use of hand calculators. We're not thinking of doing away with instruction, but of enhancing instruction."

Though this theme is repeated often by the developers of Athena, one is left wondering what the effect on student-teacher relationships will be if it does become possible to put a great deal of the technical curriculum on computers.

After the professors' assurance that computers will not replace faculty, they sometimes add that universities are having increasing difficulty in employing skilled faculty (industry pays better), and are turning often to foreign-born teachers. If pushed, some MIT professors admit that computer-enhanced learning probably will make possible a higher student-faculty ratio in technical classes.

And this opportunity worries some faculty members. The coming technology may be restricted only by the imagination of professors. Are they going to be clever enough to harness the technology to do all that it can, or that it should do? A professor who has taught his subject for a decade or so can anticipate most of the questions he will receive from students. He is probably surprised by no more than 8 to 10 percent of his students' comments. The others he has heard before. With such experience, he could conceivably program most of his course into a computer, anticipating the insightful and common student questions and remarks, with appropriate answers and comments on the disk.

Should he attempt it? Will his course still be as interesting to students on a computer screen? Students have not cared for filmed or TV lectures over the past 30 years. Would their unfavorable attitudes change if the computer provided realistic student-teacher give-and-take?

If a professor puts 80 percent of his course on the computer, what should he do with his class time? Add more content to the course? Probably. But if he is teaching Bridgepolishing I and decides to include half of the curriculum of Bridgepolishing II, what does this mean for the professor who earns his salary teaching the latter course?

Professor Moses asks, "If a computer spots a kid making an error, is it ideal to inform him immediately or should the computer allow him to flounder for a while? This is an example of what we're going to look at."

> Computers will not replace faculty.

These are some of the questions that will be explored by the MIT faculty during the next 5 years. Professors have drafted some proposals over the summer for computer-assisted learning projects. These proposals will now go to faculty committees (probably one for engineering and one for the rest of the university). In the proposals, the faculty members describe the machines, resources, and staff they will need, as well as how much time they want away from normal teaching loads, to design a piece of the new curriculum. If the project is approved then the faculty member will get his resources and begin work.

The major groundwork for Project Athena was done by Dean Wilson, Professor Moses, and Professor Michael Dertouzos, director of MIT's laboratory for computer science. They have strongly advocated increased use of university computers for education since the late 70s.

"This is an opportunity to revolutionize teaching and learning," believes Dean Johnson. "But we are not even sure that computer science can make a major contribution to teaching. We may find out that a blackboard and a piece of chalk are still the best teaching tools." ■

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Beating The System

Three teenage entrepreneurs found a clever and inexpensive way to piggyback another circuit board onto each PC expansion board, and business is booming.

Teenagers have become notorious for their precocious interest in computers, from Steve Wozniak, who developed the prototype of the original Apple computer, to the young miscreants hauled in by the FBI for monkeying with NASA's mainframe files. But it's still rare to find stripling entrepreneurs manufacturing hardware. Three hackers-turned-businessmen have not only started their own hardware firms, they have also beat the IBM PC system by inventing an inexpensive way to double the storage space on a PC.

Two brothers, 13-year-old Chris and 16-year-old Adam Hogin, and their 18-year-old stepbrother Mark Juliana, all of San Jose, California, are the principal partners in TAMAC Electronics, manufacturer of the Slot-Saver. It's a device that allows two circuit boards to be plugged into each of the five slots on the PC motherboard.

Slot-Saver kit
TAMAC Electronics
1028 Fleetwood Drive
San Jose, CA 95120
List Price: $12.95
Requires: Soldering iron, two IBM expansion or Input/Output board, screwdriver.

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"A year ago we were running out of room on the PC because it only had five slots for expansion boards. We were looking at ways to expand the unit, and there weren't any inexpensive options. So we looked at the Sigma Expander (for $500) and carefully inspected its design," Mark said.

The trio discovered that not only was the Sigma memory expander "ridiculously expensive", but it was an awkward arrangement. After examining a PC expansion board, the three found an easier way. The plastic board has a row of metal-lined holes along the bottom edge that connect the printed circuits on one side of the board to those on the other. The holes also, as it happens, connect to the gold-plated contact pins that actually plug the board into the motherboard slot.

"Those contacts are where the system unit looks to see what type of expansion peripheral you have in place, and that is the key to the whole approach," Mark said. Although the holes had been filled with solder, the boys discovered that if they removed the solder, they could use the holes as a contact point for another board. They jury-rigged a connector—two plastic fittings with pins that fit into the holes on the first expansion board—that enabled a second board to be attached parallel to the first, using its contact pins to tap into the slot.

"The first prototype wasn't quite right, and so we called around to find a connector that would work," Mark said. The partners were lucky: IBM had fortuitously made the diameter of those holes the same as that of the standard pin fittings that connect cables to circuit boards. The boys found a place that sold custom connectors

that exactly fit the holes. "We were really amazed when it worked, and the two boards could really reside in one slot; it was just great!"

Going Into Business

The transition from just another good idea to a full-fledged business came when the boys figured out that what worked for them would work for others. They suspected there were others who wanted to expand their PCs' memories without "paying through the nose," Mark said.

They started producing the Slot-Saver (as they have dubbed it) with capital from Mark's dad, Tony Juliana (Chris and Adam's stepfather). The elder Juliana, a research design engineer at IBM, prompted his son's early interest in computers when he brought home a prototype 8-bit machine 10 years ago. He taught Mark, then 8, the rudiments of programming, and by 14 the younger Juliana was second-guessing salespeople in his local computer outlet. It's not surprising, then, that Mark, who is a student at Evergreen College, was frustrated by the limitations of the PC motherboard. The three launched their business by ordering the connectors in bulk, writing and printing instructions, and designing packaging. The Slot-Saver kit, which they assemble by hand, includes 62-pin male and female connectors, easy-to-follow installation instructions, a nylon spacer with two 4-40-X-¼-inch screws, toothpicks to help push the solder out of the holes, and new solder to fix the connectors in place. That's it. You need a low-wattage soldering iron and a screwdriver to install the Slot-Saver. A desoldering tool (a hand-held suction device) would also be extremely helpful.

> The boys are about to enter the software field.

The device, which works only with IBM boards, is beautifully simple, the kind that leaves you wishing you'd thought of it first. The $12.95 price tag also makes it an economical way to put any two IBM expansion or Input/Output (I/O) boards side by side in a single slot. Not a bad achievement for a trio whose cumulative ages are less than 50!

Marketing Problems

The simplicity of the device worried the TAMAC partners at first; they were concerned that pirates would co-opt their

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idea. They knew they couldn't copyright the product design and weren't equipped to go through the complicated and painstaking patent application process.

The next best thing was a copyright for the instruction sheet. "It was better than nothing and it might prevent people from copying the manual, and ultimately, the idea," Mark said. "But, like with software, you know it [copying] will happen anyway."

Putting piracy worries aside, the partners forged ahead with marketing their product. They depended on word of mouth at first; later, they garnered some good public relations by sending press releases to computer magazines. However, sales were still weak.

In July 1983, the company advertised at the West Coast Computer Fair, and orders picked up.

So far, TAMAC has sold 300 devices out of the 1,000 it has assembled. If orders warrant it, the three can produce 5,000 kits per week. According to Mark Juliana, "The market is out there, and we have to make sure that our visibility increases."

The product works, but marketing it successfully would require national advertising, which can be prohibitively expensive for a young company. The fledgling electronics firm is not averse, however, to being bought out by a larger company. In fact, they look forward to royalties. Meanwhile, they've diversified.

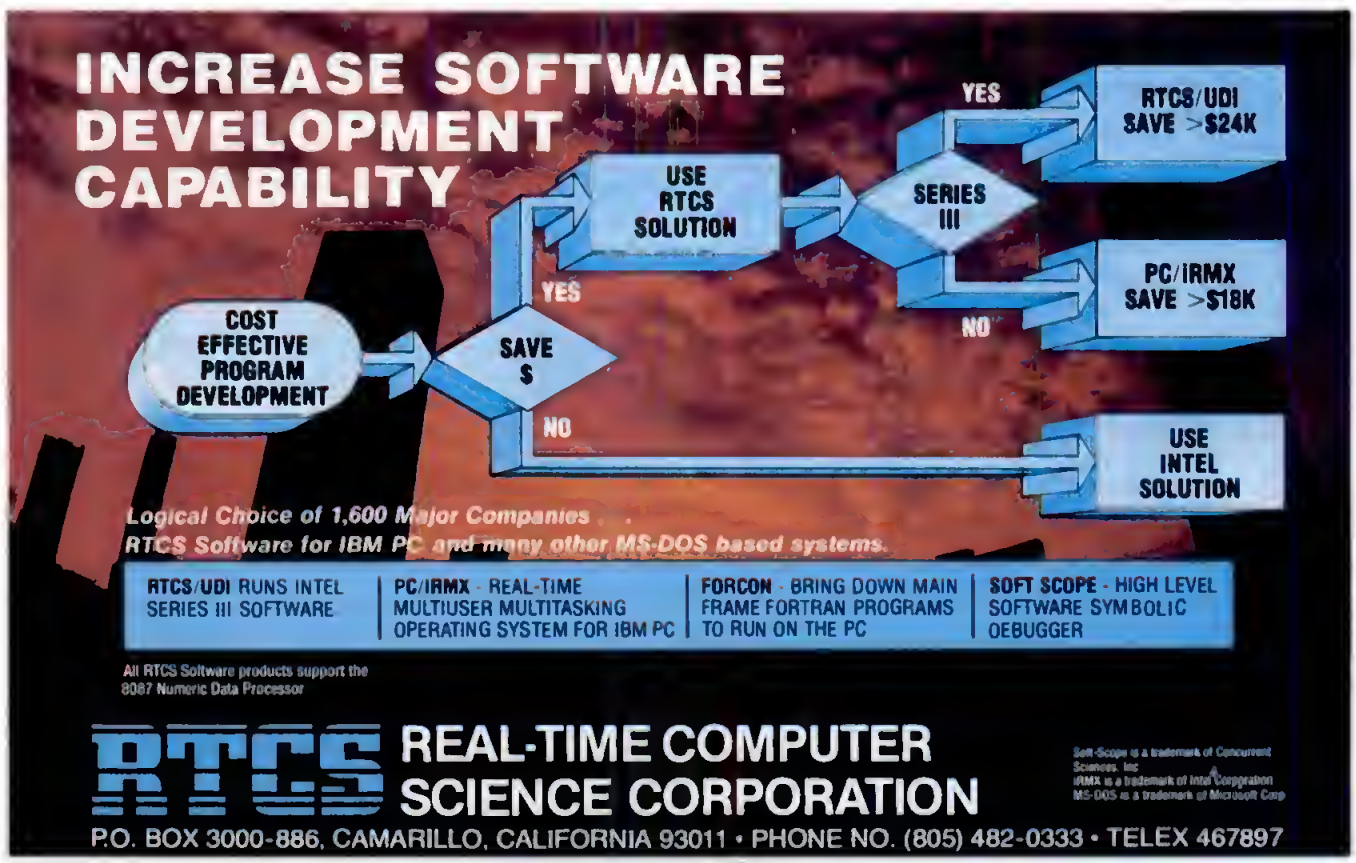
TAMAC's latest product is a lithium-driven clock/calendar board that they sell separately from a multifunction board. "The only one of its kind," according to the brothers. The clock/calendar combo board will work with a disk, which comes with it, and will sell for about $40. "Why pay for a number of features that you don't really need to get the one that you do?" says Mark.

While hardware has been the firm's primary product, the boys at TAMAC are about to enter the crowded software field too. "We'll be getting into software in the future. The MS-DOS format is constantly growing, and a lot of money can be made there," Mark said.

They're working on some business programs, as well as a checkbook manager for personal use. They're also ready to try creating their own adventure game.

Meanwhile, the three youthful entrepreneurs have realized that often the key to success is being willing to wait . . . at least until they've finished college. ■

Dawn Gordon is a writer who frequently examines computer-related subjects.



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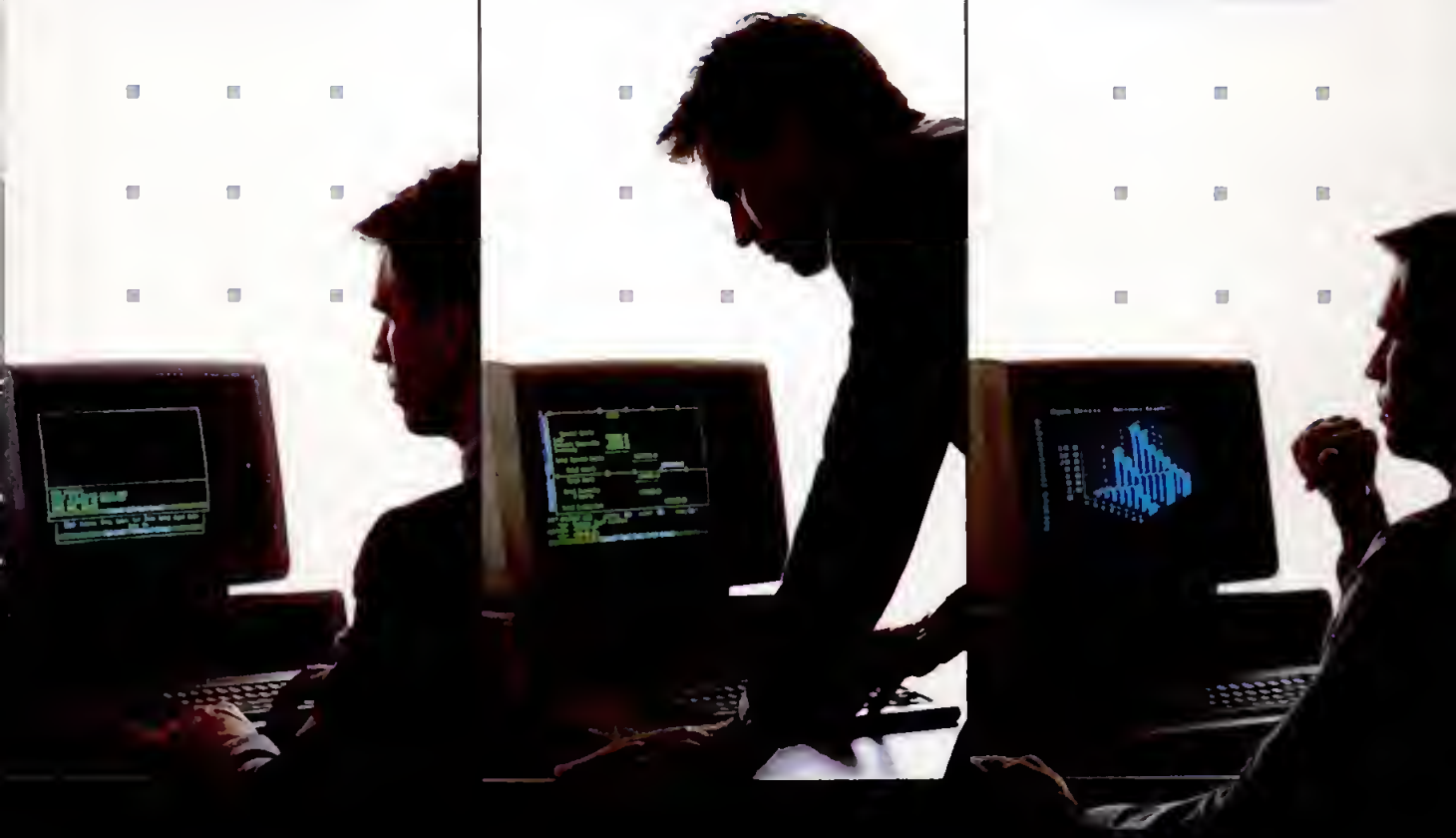

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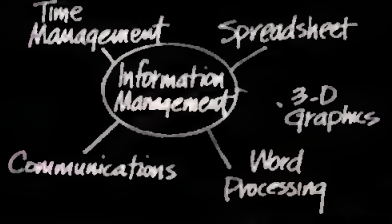
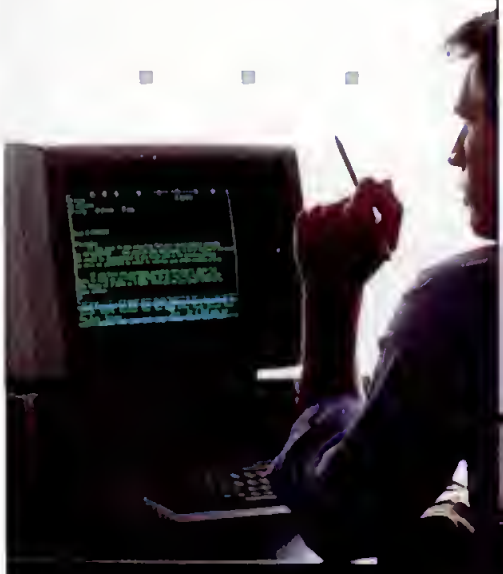
Luckily, the spreadsheet I'm using has Goal Seeking. This way, I can enter my two target values and let the spreadsheet calculate the right combination of sales volume and advertising. This way, I know I've got the right values.

I've learned that HQ doesn't like reading through reports to get the bottom line — they want to see it as clear as day. So, I'll move the spreadsheet results directly into the graphics module — in a few keystrokes I have a mountain of raw data distilled into a bright, three dimensional color bar graph.



and does Arithmetic. Your Appointments Talks to the World.

Write Your Summaries.



Fortunately, this word processor is powerful enough that I can quickly call up last year's sales report, edit the changes, copy in the spreadsheet model, and include a command to print the graphs at the end of the report.

Now, I can rewrite the critical lead paragraph to get the wording just right, perform a global search and replace to update the year, and block margin the paragraphs for a professional appearance. 9:13 am. Finished!

Communicate With Your Offices.

After a quick review of all the work done, I thank my lucky stars for the powerful communication module. This allows me to simply display HQ's phone number from a list and with the push of a button, my intelligent modem calls the number. Then, a few keystrokes and—zap—I've sent it all to Chicago by electronic bit stream. Time 10:17. I just saved five days!

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And Still Keep Your Appointments.

I expect the quality of this report to raise some eyebrows at HQ. So, I'll schedule the rest of today off since I've already finished a week's work. Fortunately, my appointment scheduling system reminds me of my dentist appointment at 4:30. I'll also schedule a briefing at 9:00 am tomorrow for the sales staff and my secretary can use the rotary card file to call everyone on the list. Well, I'm off for the golf course—Good bye!

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RAMADA
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Checking Inns With The PC

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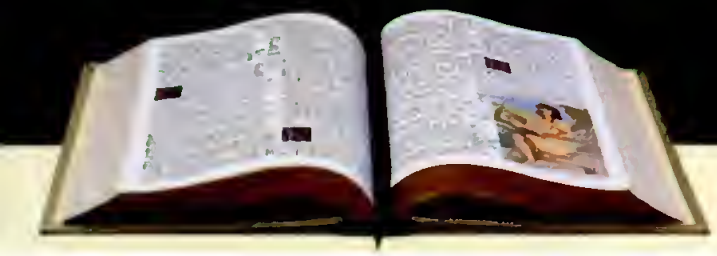

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CIRCLE 196 ON READER SERVICE CARD

CHECKING INNS

It's late at night, you've been traveling all day, and when you arrive at the front desk of the hotel in which you've booked a room, you discover the hotel clerk has no record of your reservation or your deposit. Your room is already taken, and you've been "bumped." At Ramada Inns, however, there'll be no more bumping.

In an effort to improve the accuracy and efficiency of its reservation system, Ramada Inns, Inc., has equipped more than 600 of its properties with IBM personal computers. By its own claim, Ramada is the first company in its industry to use IBM PCs as reservations terminals.

Prior to purchasing the IBM equipment, Ramada's reservation system centered around Digital Equipment Corporation KI processors and "dumb" ASCII dial-up terminals. These were installed at each of the Ramada properties in the United States and Canada. According to Nicholas Bredimus, vice-president of Ramada's Information Services Division, the older terminals were costly to maintain and inefficient.

In September 1982, Ramada Inns reevaluated the system it had in place and began to look into the personal computers then on the market. The company finally narrowed its choice down to three machines: the IBM PC, the DEC Rainbow, and Texas Instruments' Professional Computer.

"It was very fortunate for us that our requirement for so many terminals coincided with the announcement of personal computers by some leading computer vendors," Bredimus explained. "We planned to put the new terminals in this past summer, so the availability of those machines fit very nicely with our requirements. We also benefited greatly from the competitiveness of the personal computer market. When we did our initial justification, the computers were more expensive than they are now. We experienced two or three price reductions from the time the project was conceived, which made the personal computers even more attractive."

Ramada Inns executives Nicholas Bredimus (left) and Fred Miller (right) at the PC.

To achieve the maximum possible savings, Ramada dealt primarily with the vendors, after observing that third-party computer stores, such as ComputerLand, could not match the discounts the vendors were offering.

The Front-Desk Configuration

Ramada Inns eventually selected IBM PCs, each equipped with 128K bytes of main memory, a monochrome display, keyboard, and two 320K drives. Peripherals included an IBM Graftrax 80 printer and a Hayes 1200B internal modem. Ramada installed 635 PCs throughout North America in 90 calendar days. The 26 trainers responsible for the setup of the systems and the training of the users logged more than 100,000 miles during the 3-month installation period. When the computers were initially purchased, the configurations were "frozen" so that Ramada wouldn't besiege the trainers with questions about spreadsheets, word processors, and other programs. Now that the machines are installed and operating, however, Ramada is looking at other software and may even centrally purchase off-the-shelf packages for use by the individual inns.

The PCs, running under DOS 2.0, have two main programs: the Ramada proprietary synchronous communications program, called *Ramsynch*, and the reservations application. Each PC is intended to be in continuous operation with the communications program running in the background while the application program runs in the foreground. When the operating system is loaded, *Ramsynch* is loaded with it and the available memory is reduced by a proportionate amount. When a telephone call from the mainframe is received, the communications package goes into operation, taking over the computer momentarily to handle the reserva-

tion. When finished, it restores the computer to its previous state and goes into the background until called up again. In this manner, the machines—at the same time that they are being used for other tasks—are in continuous operation for the reservations system. "We don't know of anyone who is using the PC that way right now," said Bredimus. "Most people require the user to initiate the communications. With our application, the user doesn't have to be doing anything. He can be at the front desk checking in a guest when a reservation arrives without any direct user intervention."

The Mainframe Connection

Each of the PCs is connected via a commercial dial-up telephone line to Ramada's reservation system mainframe computer located at the Ramada headquarters in Phoenix, Arizona. The host mainframe is an IBM 4341 running in the VM (virtual memory) operating environment.

> The average data transmission lasts less than 30 seconds.

The 4341 maintains the central reservations database and is the heart of the reservations system. The reservations are run on a program called *ACP (Airline Control Program)* that was developed by IBM. *ACP* is a transaction-based system used by most major airlines, hotels, and rental car companies.

Ramada leased the basic *ACP* from IBM, acquired the rights to *ACP* enhancements developed by both the Westin Hotels and the Best Western Hotels, and then invested between 10 and 15 man-years in additional enhancements. The result is a reservations system that Ramada calls RoomFinder II.

"If you make a reservation through our 800 number, it goes into the central system. From there it is stored-and-forwarded to the hotel that you are actually staying at," explained Fred Miller, vice-president of reservations for the Ramada Hotel Group. "If the hotel loses the reservation, it can be recalled from the mainframe computer."

According to Miller, there is virtually no delay between the receipt of the reservation by the mainframe and its transmission to the appropriate hotel, and the average data transmission lasts less than 30 seconds. *(continued)*

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CIRCLE 132 ON READER SERVICE CARD

Even so, Bredimus noted, there is quite a bit of "overhead" in the transmission. For example, if a reservation message is 350 characters long, the communications program tacks on a check-sum number representing the ASCII numerical sum of all of the characters in the message. If the receiving computer does not calculate the same number, then the message is automatically transmitted again.

Despite the use of check-sums and automatic resending, Ramada Inns still runs into communications difficulties, which are often regional in nature. Bredimus cited some problems currently being encountered in parts of Florida where MCI, the long-distance telephone carrier used by Ramada for outgoing calls, has to hand the call off to RCA, which then hands it off to GTE, which finally hands off to the local Florida operating company. "By the time it gets there, the transmission levels are such that we have a big problem with reliability."

```
                                                        01-01-1980
                                                          01:18:02

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   AIRLINE DESK          C GAME ROOM        $ MOVIES/IN ROOM    $ ROLLAWAY
 Y ALARM SYSTEM          C GIFT SHOP          MULI-LNGD STAFF   Y ROOM SERVICE
   BABYSITTING             GOLF               NURSERY             SAFE DEPOSIT
 $ BARBER                Y ICE MACHINES     Y PHONE/LOCAL         SAUNA
 $ BEAUTY SHOP           Y IRONING BOARDS   Y PLAYGROUND          SECRETARIAL
   BELLMAN                 JACUZZI          Y POOL/INDOOR       Y T V  CABLE
 Y COURTESY CAR          $ LAUNDROMATS      Y POOL/OUTDOOR      Y T V  COLOR
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GAME ROOM 24HR/GIFT SHOP 8AM-10PM/LIVE ENTERTAINMENT TH-SN 9PM-1PM
:
```

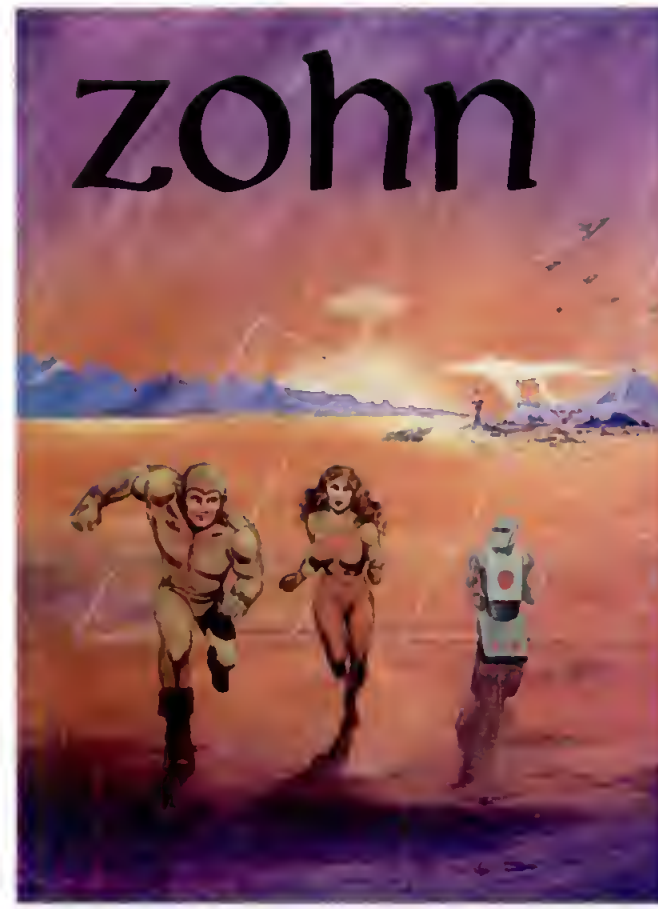
Figure 1: *A typical single-screen description of a Ramada property, listing what features are available. Each property in the company's chain has a similar listing backed up by as many as 11 pages of narrative information.*

Flexibility for the Innkeeper

Local problems not withstanding, the communications generally cause few problems for either Ramada or its guests, and the use of the central database—updatable as required by the individual inns through their PCs—allows great flexibility.

For example, *RoomFinder II* gives the individual innkeeper the chance to market

In the year 2525 man's influence has stretched to the farthest reaches of the galaxy. Colonies have been established on uninhabited planets to advance civilization to all parts of the galaxy. All has gone well until one day several small colonies are attacked and destroyed by unknown assailants. Join Zohn in his search to find the assailants and stop their destruction of the colonies.



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CIRCLE 471 ON READER SERVICE CARD

Innkeeper's Helper

PCs assist in a variety of chores.

Ramada uses nearly 20 additional IBM PCs in its Phoenix headquarters for functions that are not directly related to the reservations system.

In the Real Estate Department, PCs are used for investment analysis and forecasting, as well as for the more common tasks of budgeting (spreadsheet analysis) and word processing.

The Information Services Department uses PCs to track the different aspects of complex tasks in major projects and to handle the scheduling of communications projects.

For the Financial Planning Department, a plotter has been added to help produce presentation graphics and to assist with financial and investment analysis, and the PC is regularly used to communicate with outside databases.

The Tax Department uses a PC for financial analysis and budgeting, while Purchasing has a PC handling its budget.

If you like to gamble, then a PC may have your number. Ramada uses two PCs at the Tropicana Hotel and Country Club in Las Vegas for unique applications. One is used to keep track of the likes and dislikes of customers.

If you've ever taken a bus trip to the Tropicana, then the second PC may have had a role in scheduling your arrival. Wire sensors on slot machines are hooked up to the PC to keep track of the number of plays, types of plays, and wins and losses, so that the Tropicana's management will have information on how the time of day and events such as the arrival of bus tours affect slot play.

So the next time you pull a slot machine handle at the Tropicana, just whisper "Big Blue" three times and you may improve your luck.—**F.V.**

```
                RAMADA RESERVATION CONFIRMATION

MS. KRISTI L KELLY, THE GENERAL MANAGER AT
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PLEASE BE ADVISED OF 6PM HOLD.

YOUR CONFIRMATION NUMBER IS OXFA26-AD.
                                                    BY JC AT TSTAM

                          THANK YOU
```

Figure 2: *A sample reservation confirmation. This would be handed to a Ramada guest making an advance reservation at another Ramada Inn.*

```
                        WHAT IS THE MAIN DIRECTORY?

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      THE NEXT FIELD.
  - EVERY SCREEN HAS A HELP PAGE TO ASSIST YOU.  SIMPLY PRESS F10 AND READ THE
      SPECIAL NOTES REFERRING TO THAT SCREEN.  IF YOU WERE IN THE MIDDLE OF A
      SCREEN WHEN YOU ASKED FOR HELP, PRESS ↵ TO RETURN TO YOUR ORIGINAL
      SCREEN.  ALL THE INFORMATION YOU ENTERED WILL STILL BE THERE.
  - EVERY FIELD HAS AN INSTRUCTION LINE NEAR THE BOTTOM OF THE SCREEN TO ASSIST
      YOU IN COMPLETING THE FIELD YOU ARE IN.  IT IS LOCATED JUST ABOVE THE
      LAST LINE ON YOUR SCREEN AND IS IN REVERSE VIDEO.  THIS LINE IS SHOWN
      HERE MARKED 'THIS IS THE INSTRUCTION LINE'.
  - NOTE THE ABBREVIATED FUNCTION KEY (Fx) LABELS AT THE BOTTOM OF THE SCREEN.

                        THIS IS THE INSTRUCTION LINE
F1 MAIN F2RESVTNF3STATUSF4 MSGS F5HOTELSF6SLSRPTF7 MISC F8GUIDEF9      F10 HELP
```

Figure 3: *A description of the main directory screen that tells the operator how to utilize it properly.*

his individual properties through the central database. Thus, any innkeeper can make available nationwide to other innkeepers a fairly complete description of his property and all of its amenities (see Figure 1).

The *RoomFinder II* database contains 11 pages of descriptive information on the hotels, including a physical description of the property, a listing of nearby entertainment, the inn's distance and direction from the airport, and descriptions of the rooms. Each Ramada property can have up to 24 different types of rooms, each with a specific price and an individual description, so that, for example, a reservations agent can explain to a guest the difference between a $50 single and a $60 single.

If a traveler is at a Ramada Inn and wishes to make a reservation at another Ramada Inn for a future date, the innkeeper can make that reservation through the PC and provide the guest with a written confirmation (See Figure 2).

If an inn experiences a surge of walk-in customers, or if a particular type of room is selling out quickly, the innkeeper can

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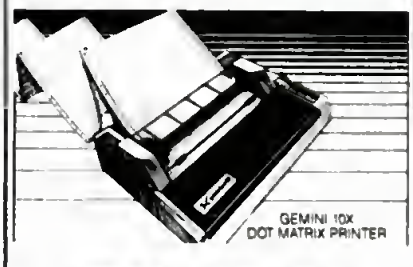

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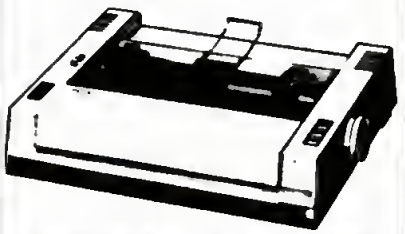

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CIRCLE 832 ON READER SERVICE CARD

CHECKING INNS

use a screen on the PC to advise *Room-Finder II* of the shortage, thus preventing overbooking of the inn—and frustrated travelers.

In addition to the reservations application, certain administrative functions are carried out on the PC through the electronic mail network. If a message has to be sent to all properties, the information is entered into the database and piggybacked onto reservations being sent to individual properties. If there is no transmission going to a particular inn, then the message is sent at the end of the day or earlier if required. The inns usually generate more administrative messages than does Ramada's reservations group, Miller said. "The properties have traffic for us, such as changes in room status, reservations, and messages for other properties, or sending in a daily status report. They have more types of messages for us than we have for them."

The system can prove its usefulness, of course, only if the innkeepers don't circumvent it by simply picking up the telephone and calling either the reservations office or the other inns they need to speak with, which they might do out of force of habit.

Both Miller and Bredimus, however, believe that even the most inexperienced employees in the hotels can easily make a reservation through the computer system.

No Room For Hackers

An elaborate security system prevents unauthorized access to the Ramada Inn reservation system.

With a North American network of more than 600 personal computers calling or being called by its mainframe computer in Phoenix, is Ramada concerned about the possibility of pranksters getting into the system?

According to Fred Miller, vice-president of reservations, Ramada did look at the possibility of surreptitious entry into their system and developed a method to foil any such attempts.

"Even if you had an identically configured personal computer, you could not—as a hacker—get into our computer," Miller said. "First of all, you'd have to have our communications diskette. Even if you somehow obtained one of those, you'd still have to be at the telephone number that we expect you to be at," he explained.

When an innkeeper tells the PC to call into the mainframe, the first thing to happen is that the PC's keyboard is frozen and the screen says "security check." The Ramada communications software then automatically dials the host computer in Phoenix and when the connection is made, provides its serial number and disconnects.

The mainframe then researches the serial number, verifies that it is a valid copy of the software, then dials back using the telephone number stored in Ramada's records. Thus, even a hacker with a copy of the software could not get the mainframe to return the call to the hacker's telephone number.

When the mainframe reconnects, it signals "security check complete," and the innkeeper can operate for the remainder of the day.

If there is a problem, or attempted illegal access, then an alert message is sent to a control center that is manned 24 hours a day, where personnel are informed of the possible trouble.

Miller indicated that even after the mainframe has reestablished the connection, there are additional security measures in place.—F.V.

The reservations program helps the user each step of the way and makes extensive use of a fill-in-the-blanks screen format (see Figure 3).

The Personal Touch

In addition to providing the traveler with a personalized written confirmation, the reservation system has a personal message on the screen for the hotel employee who is assisting the traveler. The message says: "Thanks (name) for confirming the reservation. Please advise the guest of his confirmation number, which is . . . . . Please ask for additional reservations." "We've tried to get humanity in on both ends of it," Miller noted.

RoomFinder II can be accessed directly by the airline reservation computer systems, which means that any airline or travel agent can make and confirm reservations with Ramada Inns. The system interface is with the IBM 4341 in Phoenix, which passes airline and travel agent reservations along to the individual PCs as if they were generated internally.

So when can *PC* readers expect to make their Ramada reservations directly? Not for a long time. Security measures are in place to prevent hackers from gaining access to the system (see sidebar, "No Room For Hackers"), and Ramada doesn't plan to participate in any electronic "home shopper service" in the near future. According to Miller, Ramada did look at some of the electronic shop-at-home services being installed in various parts of the country and decided that consumer acceptance was lacking and the quality of products insufficient to justify the cost of signing up. Miller does feel that such a service will be available "somewhere down the pike." As an alternative, Ramada Inn enables frequent travellers to punch in reservations on a touchtone telephone and to receive an audio confirmation of them.

Placing the reservations system on a PC–mainframe network was a technical feat. Further expansion, according to Bredimus, will be a marketing decision. ■

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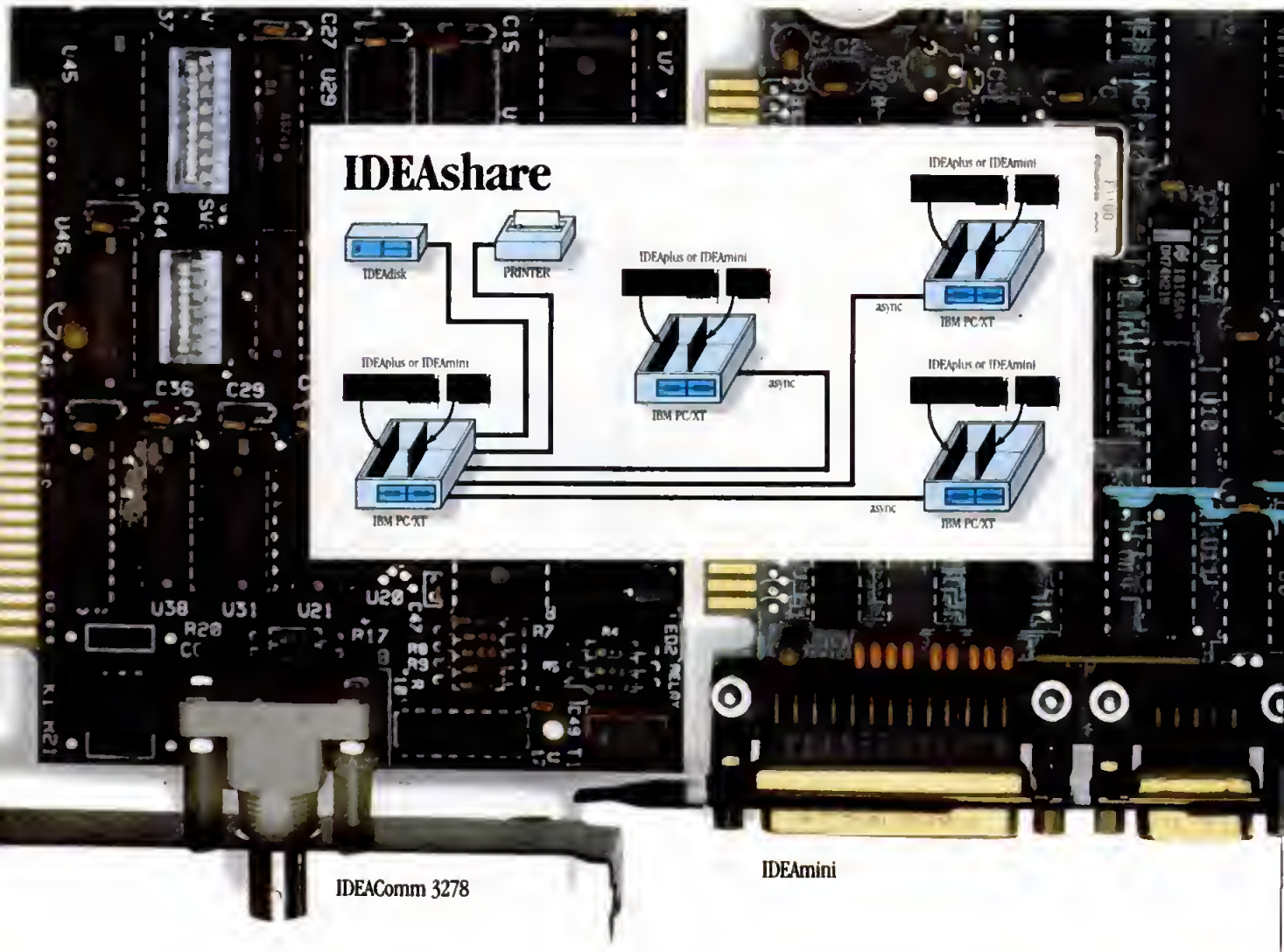

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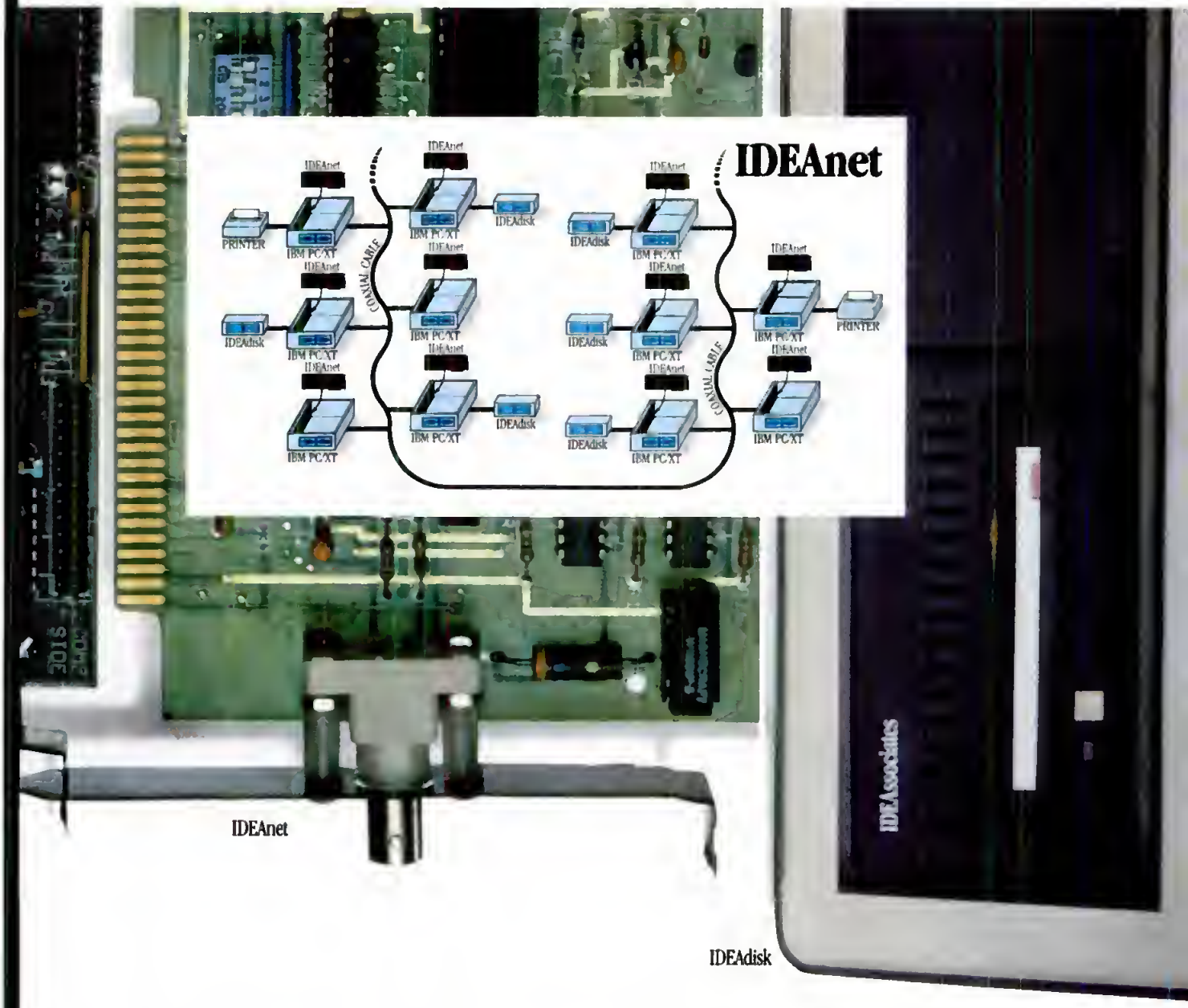

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Waking Up To Computer Education

With 135 IBM PCs installed in its middle schools, North Carolina's Wake County school system has made a strong commitment to computer literacy for all its students.

At schools around the country, officials are devising computer training strategies more complicated than a *PacMan* game—far more. Administrators and teachers are coming face to face with how much they have to learn—and do—to bring computer education to their students. In the rolling hills of North Carolina, a school system has faced the problem head on by designing a program around the IBM PC to meet present educational needs while allowing for expansion in future years.

Wake County Public School System includes the city of Raleigh and the surrounding rural areas. In the fall of 1983, students in the system's 16 middle schools began tapping away on IBM PC keyboards under the watchful eyes of their teachers, the cartoon character Snoopy, and other "friendly creatures." Brightly colored posters of Snoopy and of bugs parading across the wall proclaim, "Don't let computing bug you." In another classroom, an entire wall is devoted to posters and clippings on computer career opportunities. On the opposite wall, just above a pair of boys bent over their PCs in an attitude of keen concentration, is a poster with a chick emerging from its shell. It's captioned, "Arise, go forth, and conquer."

A year and a half ago, taking this motto to heart, Wake County's school administration formed a task force to assess how the computer should fit into the county schools' curriculum. The director of high schools and task force head Joe Moody handpicked a nine-member team from the central office so that it would represent a variety of backgrounds and perspectives. Team members would decide how the county would combine computers and teaching in the coming years. Their responsibilities included preparing a status report, developing a program of implementation for the first year, and outlining what might work for future years.

The first thing the team noticed about the county's computer curriculum was a big gap in the middle school program. There were some computers in the ele-

mentary and high schools, but few or none in the middle schools (grades 6–8). "The way it was set up wasn't at all productive," said Moody. "Having had some exposure to computers in elementary school, the kids were getting to the middle schools and saying, 'Hey, what's next?' And we didn't have the equipment or personnel to offer them what they needed . . . We didn't even have the basics. That's when we realized the emphasis should be on the middle schools first."

Once the school administration's task force made its initial survey of what the schools in Wake County had, it began developing a way to implement computer education for the middle schools. In an overall revision of the middle school curriculum, students were given more choices in shaping their programs of study. "Under the umbrella of the elective program, we wanted computers to be one of those choices," said Gerry Ritter, director of middle schools and a strong advocate of introducing computers into the schools. "But it's more than that. I don't want to see a computer gap develop with these students. It's important for all youngsters to have computer training now and have it grow with them in their later school years. This is the best age for kids to explore computing."

The focus in Wake County's middle school classes this year is on computer literacy, problem solving, and, to a lesser extent, programming skills. In a second phase, students will use the computer to study the traditional subject areas—history, language, and so forth. "These are the kids who will be the 21st-century workforce," explained Ritter. "They will need computer skills no matter what they choose as a career—math, science, language arts, or social science."

The county allotted a total of about $300,000 to outfit a lab for each of the middle schools this year. The plan is to equip the high schools in the 1984–1985 school year and the elementary schools the following year. The high school lab is in the planning stages now.

In-Service Training

One thing the task force learned from the first year's experience is that training of high school teachers should begin early. "We will definitely start training before the summer, as we did with the middle school teachers," said Moody. "We would also have liked to spend more time detailing a long-range plan and the uses of the configuration."

Accordingly, the county bought more

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than 135 computers with matching software. It also bought in-service training. "We couldn't afford to have the vendor drop off the computer and then ride into the sunset," Moody observed. "We knew there was a lot of good hardware out there, but we were particularly interested in the kind of support the company could offer us. That is our greatest need. We can't train people fast enough."

The task force had to determine, in very concrete terms, what the objectives would be for the middle school and what their needs would be for hardware, software, and in-service training. After listing the requirements by priority, the task force came up with the IBM PC as the best machine for its purposes. The extensive in-service training the company provided was only one of the major reasons why Wake County settled on IBM. "We feel IBM's state-of-the-art hardware will be able to handle upcoming software," said Moody. Recent trends in software favor the IBM PC's 16-bit microprocessor.

> We should go with the company that will set the standard in the industry.

"We also feel that IBM is moving so rapidly in software development that we should go with the company that will set the standard in the industry—in hardware and software."

The task force's decision to buy IBM computers still was a long way away from full implementation. For one thing, the state educational system has procurement regulations governing large purchases. "We had to go through a bidding process," explained Moody. "If you're going to buy something that costs more, then you have to justify where the public dollars are being spent." The task force drew up a list of the mandatory and desirable specifications, and the state obtained several bids on the project, then awarded the contract to the lowest bidder to meet all the mandatory requirements. IBM prevailed in the bidding and signed a 1-year contract with Wake County.

The contract provided the schools with a 30 percent discount off the list price. It also obligated IBM to help the county school system set up its own parts and service department. "By having our own maintenance department, we've been able to cut down on the turnaround time and

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cost of repairs," said Moody. IBM supplied training for two maintenance people and established a procedure for ordering IBM parts with a maximum delivery time of three days.

The first priority for computer education in Wake County's middle schools has been to give each student some initial exposure to computers and then in future years to provide increased instruction and hands-on use. "Our major concern is that all of our children have some access to the skills from a literacy perspective—just knowing what a computer is and what it can do," declared Ritter.

To achieve this goal, each of the middle schools was outfitted with a fully equipped lab, consisting of 10 monochrome IBM PCs each with an additional 64K of RAM added at the factory, two disk drives per computer, and a printer for each lab. The county's two "Gifted and Talented" schools were already well equipped, so attention was focused on the other 14 middle schools in the Wake County public school system. "We went in and supplemented what each school already had, providing anywhere from five to ten computers," said Moody. With just two to four students working at each computer, each school has the capacity to offer a full one-third of its students a class in computing.

All of the schools are offering the same four classes this year; next year the curriculum will expand. "Computeronics" introduces the team problem-solving approach to the beginner who has some anxiety about computers. Students are placed in two-person teams, which work together to solve problems on the computer. There is no predetermined way for approaching each problem and teams are expected to proceed in their own ways. For the student who wants to learn more about word processing and spreadsheets, there is "Personal Computing," a class that uses *EasyWriter* and *VisiCalc*. On a more advanced level there is "Compters, Computers, Computers," a class in structured BASIC. A fourth class in Pascal is taught only at three of the schools in the system.

Middle school students are given the opportunity to work on their own.

A Magnet School

One of the schools offering Pascal is Daniels Middle School. It's the only school in the county where all students have the opportunity to take a full-semester computer class in the 1983–1984 school year. Principal Peggy Holliday estimates that 57 percent of her students took such a class the first semester and the other 43 percent will have the option to do so the second semester. "Once everyone has been introduced, the priority next year will go to the incoming sixth graders and the seventh and eighth graders who come into the school as a magnet school."

> Each school has the capacity to offer one-third of its students a class in computing.

Daniels is a magnet school that students with a particular interest in computers can attend if they live within the county boundaries. This is the second year of Wake County's magnet school program in which inner-city schools offer some special emphasis as a way of drawing students into the city from the suburbs for purposes of desegregation. Daniels, located in an old section of Raleigh where few school-age children live, was made the math, science, and technology magnet this year. Despite its lovely setting—a tree-covered hill surrounded by homes built at the turn of the century—the school once faced a declining enrollment. Now, with 39 new

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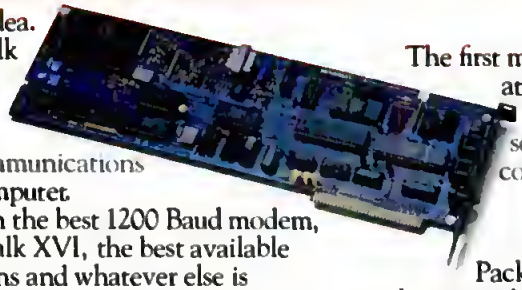

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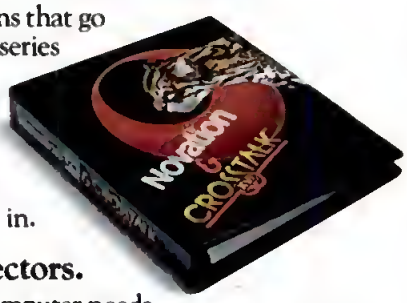

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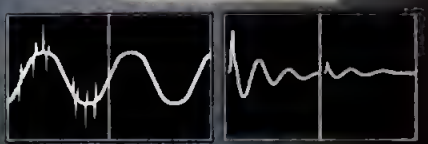

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Teachers give specialized attention to their students.

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IBM PCs, there are almost 1,200 students and a waiting list for next year.

"Our computer lab is definitely a drawing card," asserted Holliday. The main lab has 30 computers split into three classrooms; the other nine are in the lab in the school's second building. At Daniels the administration tries to maintain a ratio of two students per computer and one teacher for every ten computers.

Teachers give specialized attention to their students. While Jeanne Nerone is teaching Pascal in one room, Mary Ann Bardon is showing the kids in her "Personal Computing" class how to put together a letter. And on the other side of a glass wall separating the second and third classrooms, Emily Barfield is peering at the rabbit on one student's screen as the student asks, "Are the ears supposed to be hollow?" Teaching methods are varied. *VisiCalc* is used to tally the school soccer team's wins and losses and *EasyWriter* for writing a letter to the governor asking for his favorite recipe to put in the class cookbook. The approach works.

Mary Ann Bardon has noticed a big difference in classroom behavior since the new computers arrived. "It's a great motivator," she said. "You can pair a slow learner with one whose skills are higher, and it's amazing the progress they make together." She has one student in class who has gained self-confidence from working with computers. "It's the kind of thing where a student can do something specific and see that he has completed it and done it well."

The school once faced a declining enrollment. Now, with 39 PCs, there is a waiting list.

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Exploring A Nonmanual Alternative

Though IBM's new introductory program for its Personal Computer gives new meaning to the hackneyed phrase "user-friendly," it still has a long way to go.

When the IBM PC first came out in 1981, a big deal was made about the attractiveness of the manuals. While other computer companies shipped out smudgy copies of the programmer's dot matrix-printed cribsheets, IBM gave us tastefully bound, neatly typeset, three-ring notebook binders in little standalone jackets. Alas, from where I sat, trying to figure out how to copy command.com onto *WordStar*, I felt like the scullery maid in the electronic cottage. It wouldn't have mattered to me if the manual had arrived between the covers of the Book of Kells. Attractiveness only goes so far, especially when you've just spent five grand on a system that just sits there saying A>.

First, the Good News

The good news is that IBM is now distributing an introductory program called *Exploring the IBM Personal Computer* with every PC and XT it sells. (Actually the package consists of two virtually identical programs, both designed by Digital Learning Systems, Inc.; one for monochrome display, the other for a color monitor. Both are copy-protected.) Learning hands-on and with the interactive feedback that only software provides is terrific, especially for beginners.

Since the program is much needed and costs nothing, criticizing it may sound like looking a gift horse in the disk drive. However, like many computer products, *Exploring* looks great when compared to what used to be, not to what should be.

The program comes with a sheet that coaxes new users through the initial hurdles of opening the drive door, properly inserting the diskette and turning on the machine. From there you're greeted with pseudo-trumpets and calliopes belting out march tunes from the tinny IBM speaker. You're served up large dollops of user-friendliness ("This program has pages and chapters, just like a book") and told that

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NONMANUAL ALTERNATIVE

you'll be introduced to several different areas of your computer: the keyboard, disks and the operating system, BASIC, and IBM (Epson) printer. Before you start, you're explicitly shown how to move around the program, using the PgUp and PgDn keys to move from page to page, the Alt-PgUp combination to review the chapter you've just studied, ALT-PgDn to skip to the next chapter, and Escape to dispense with the sound effects.

The lesson on the keyboard is a straightforward attempt to familiarize you with the cursor and the other keys that don't appear on a typewriter. After some practice exercises, the program moves onto a segment called "FunWriter—the greatest show in word processing." ("Even if you've never used a word processor before, you'll like this one! Besides being fun, it's great keyboard practice.") Like a genuine word processing program, FunWriter assigns various function keys to various editing chores (cut, paste, print) and teaches you how to use them. Other function keys are assigned to such flashy but distinctly non-word-processing jobs as turning a "radio" on and off and making some hearts from the alternate character set twinkle and frolic round the screen. Overall, there's a frenzied attempt to keep everyone's spirits up. *Exploring* includes corny jokes that were no doubt cleverly designed to make the novice feel superior to Boca Raton programming wizards and therefore gain computer confidence. (Sample: Orville: "Any chance it'll fly?" Wilbur: "Sure! This machine has the Wright stuff!")

The next chapter, which focuses on disk drives and DOS, explains the difference between drive A and B and between floppies and "fixed disks," shows what a write-protect notch is and gives some pointers on the care and handling of floppies. Again, the program takes care to be entertaining (a little caterpillar moves across the screen and takes a sound effects-enhanced chomp out of a floppy to show us that "accidents will happen") and to reassure you that nothing scary is happening here ("A file on your disk or diskette is like a folder in a file cabinet.").

Using informative graphics, the program then lets you practice "copying" a file from one diskette to another. As you enter the actual copy command, you can see it type out on a make-believe monitor pictured at the top of your screen. Two floppy disks, side by side, are pictured on the bottom. At your command, a string of graphics characters clones itself and trav-

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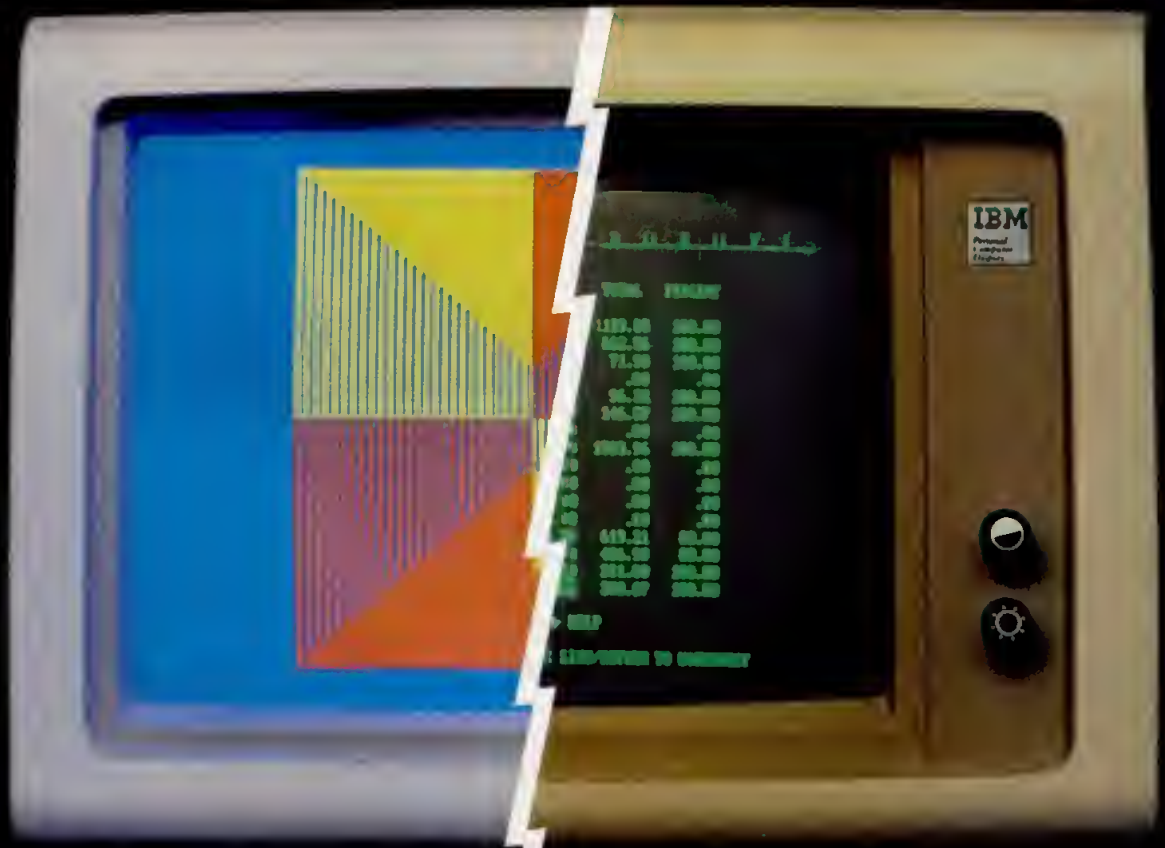

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els from the first floppy to the second. You can move files back and forth until you master the command. Similar visuals are provided to teach you the commands DIR, FORMAT, and DISKCOPY; together they unquestionably constitute the most helpful part of the program.

If you try any fancy stuff, such as comparing your simulated disks with the DISKCOMP command, you're admonished: "Please don't use any other commands until you have finished learning DIR, FORMAT, COPY and DISKCOPY. When you get to the 'For Experts Only' page you can play to your heart's content." As it turns out, there's not much playing. The "experts" corner contains descriptions of other DOS commands, but no demonstrations.

As an experienced user, I had a few quarrels with the DOS section. When you're asked to give the time and date upon booting up, *Exploring* doesn't tell you that you have the option to press "return" and get on with it. Nor does it tell you that you don't have to format a diskette before using it as your target disk within DISKCOPY. It tells you to write "dir A:" when faced with the A> prompt, when a simple "dir" will do. These, I admit, may be points that a novice could care less about. On the other hand, while the program acknowledges that several versions of DOS exist, many of its references are clearly to DOS 2.0 and could be confusing to new users. I also would have liked a more explicit discussion of when to use COPY and when to use DISKCOPY. The difference is not as obvious as it seems, and the two commands are easily confused—sometimes with disastrous results.

The Basics of BASIC

Unlike the keyboard and DOS sections, which are fairly long, the BASIC section of *Exploring* is virtually *pro forma*. We learn how to clear the screen and write one little four-line program, and then we're on our way. (Again, I was irritated that the program told novices to put quote marks at the end of a file; i.e. load "clock" instead of load "clock. Doesn't anyone know that people buy computers to save time?)

That the lesson is short is not necessarily bad. The instructions accompanying the software do contain the warning, "Don't expect to learn everything you need to know about DOS and BASIC from this diskette. It is merely a tool to acquaint you with your IBM Personal Computer." A more extensive BASIC section might also discourage people from buying IBM's very good *BASIC Primer*

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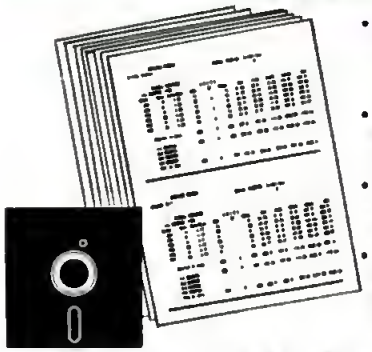

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NONMANUAL

from its Education Series line of software.

The final section, on the IBM printer, contains more helpful and clever graphics. (The lesson prints out—bidirectionally, of course—on mock fan-fold paper scrolling out of a mock printer, with ricky-ticky

Why do you have to erase a diskette you've never used before?

sound effects.) My main objection to this section is that it completely overlooks those of us who own other makes of printers. Many of the printer functions the program discusses (for example, using Shift-PrtSc key combination to print out the contents of your screen) are fairly universal, but you'd never know it. This oversight seems especially odd now that IBM itself is selling a second printer, the letter-quality NEC 3550.

Despite these quibbles, my general reaction to *Exploring* was "Gee, if only they'd had this then!" I decided to try the program out on a genuine novice, so I recruited Pamela, a college graduate who knows how to operate music synthesizers but is inexperienced at computers. If anything, I worried that she was too technically oriented to be my guinea pig.

Pamela's problems with the program began upon booting up. The accompanying instruction sheet notes that upon turning the computer on, "after a few seconds you should see the title *IBM* in large letters. If you don't, open the diskette door and remove your diskette. Start again." Such advice may be fine for those lean souls who own 64K computers, but my 256K RAM machine takes longer than "a few seconds" to power up, and Pamela had already moved to turn off the machine. (Watching her, I recalled with hideous clarity all the things I had *really* wanted to know that day the three boxes containing my PC arrived at my door-

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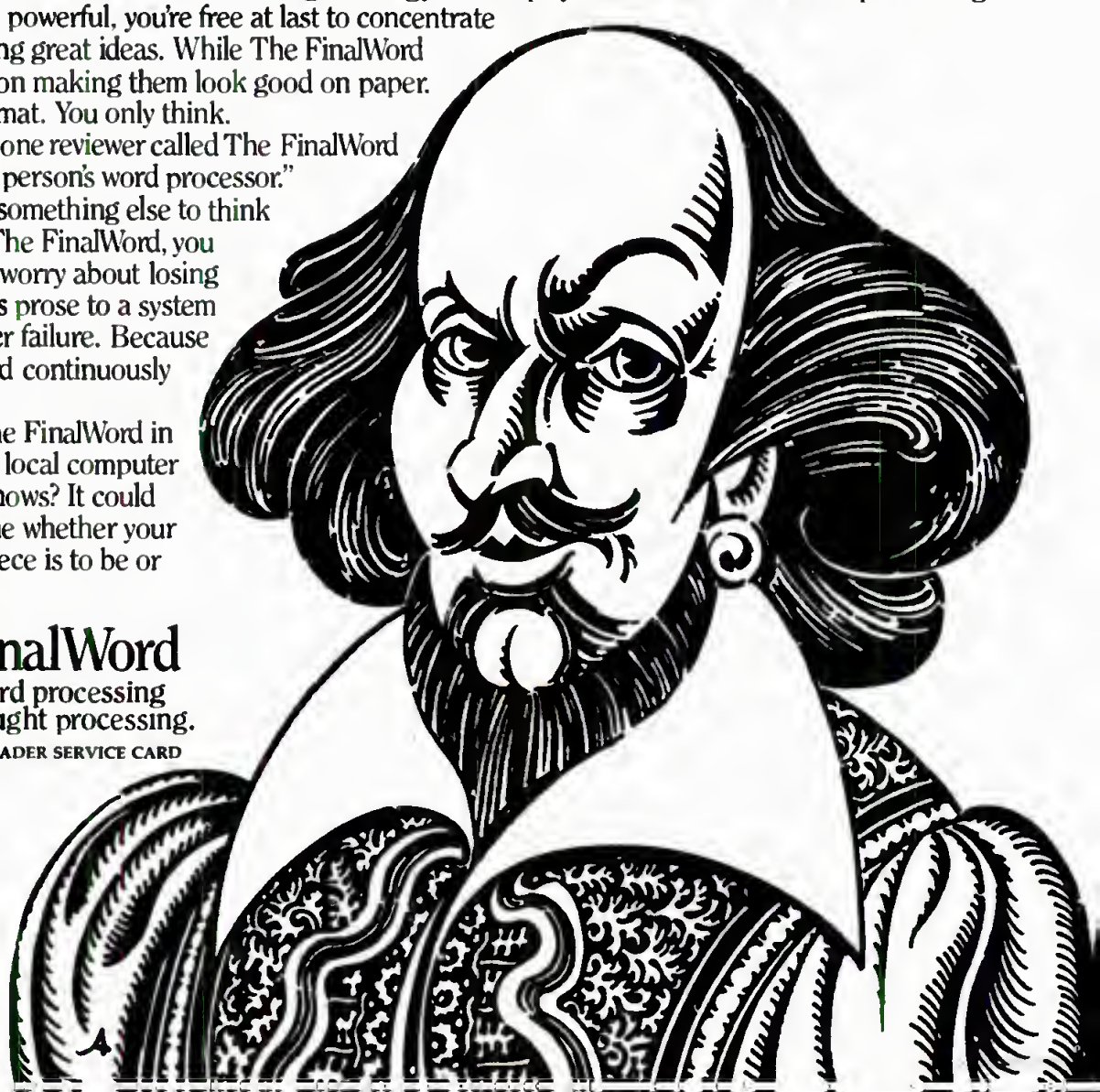

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NONMANUAL ALTERNATIVE

step—mainly, "What the hell is that noise?")

Command Overload

The keyboard lesson went routinely, except for the FunWriter section. Essentially, Pamela resented learning an entire set of commands which in fact had nothing to do with any "real" program, like *WordStar* or *MultiMate*. It's possible that she might have felt otherwise if FunWriter had appeared later in the program, after she'd learned some actual DOS commands. As it was, by the time she got to the DOS commands, she was overloaded. The program does inform the user not to be "surprised to see certain keys used differently from one program to the next," but giving fair warning isn't really the point. Pamela, like most novices, felt somewhat overwhelmed by the staggering repertoire of commands at her fingertips, and she was trying to absorb a great deal of information. It was confusing to have to divide that information between what was to be remembered and what was to be discarded.

While I found the language delightfully jargon-free, Pamela sometimes did not. The definition "a file is a collection of information," for instance, struck her as less helpful than the explanation that a file is likely to be a report, a letter, or an article. She was also stopped by this inaccurate as well as misleading statement in the section on disks and DOS: "Before you can use a new diskette, you have to erase it and make a new directory with the FORMAT command." Why, she wondered, do you have to erase a diskette you've never used before? She was also confused by the word "format," which seemed to refer only to creating directories, not to preparing a diskette to receive data.

Probably the most frustrating aspects of the program were the error messages. Like most new users, Pamela hadn't yet learned that computers are shamefully literally-minded creatures. The program didn't bother to point it out, either. Instructed to type "A:FILENAME," she typed: "a: filename," inserting an incorrect space. The program instantly spat out "Invalid number of parameters," followed by the program's pathetic stab at user-friendliness: "Don't worry! This nasty message only means that you left something out or put something extra in." But what? Pamela incorrectly assumed that her error had been using lower case letters, and was soon ready to punch in the monitor. That spaces matter a lot in DOS, and not at all in BASIC, is exactly the kind of information that beginners need up front.

More on Disks and DOS

As we pressed on, it became clear that the entire disks and DOS section could be overhauled. My vote is to chuck *FunWriter* and the BASIC lesson and concentrate more on other DOS commands. For example, I remember that it took me eons to understand the difference between the ROM-based "internal" commands like DIR, COPY, and ERASE that can be evoked within any DOS-based program at the prompt, and those disk-based "external" commands like CHKDSK, FORMAT, and DISKCOPY which have to be physically copied onto other program disks or invoked via the DOS disk. An explanation of these two types of commands would be invaluable to the new PC owner, as would a discussion of the difference between the regular FORMAT command, which simply sets up the appropriate sectors and file allocation table on a disk, and the FORMAT/S command, which copies the command.com file onto your disk and makes it possible for you to copy other commands onto the same disk.

Less crucial but also extremely useful would be some brief instruction in the autoexec.bat command, which most of us kick ourselves for not discovering sooner, and some mention of the time-saving wild-card characters.

Even with its flaws, *Exploring the IBM Personal Computer* is a whole lot easier to deal with than the DOS manual. I don't know if I'd call it user-friendly, but it's definitely user-polite. ■

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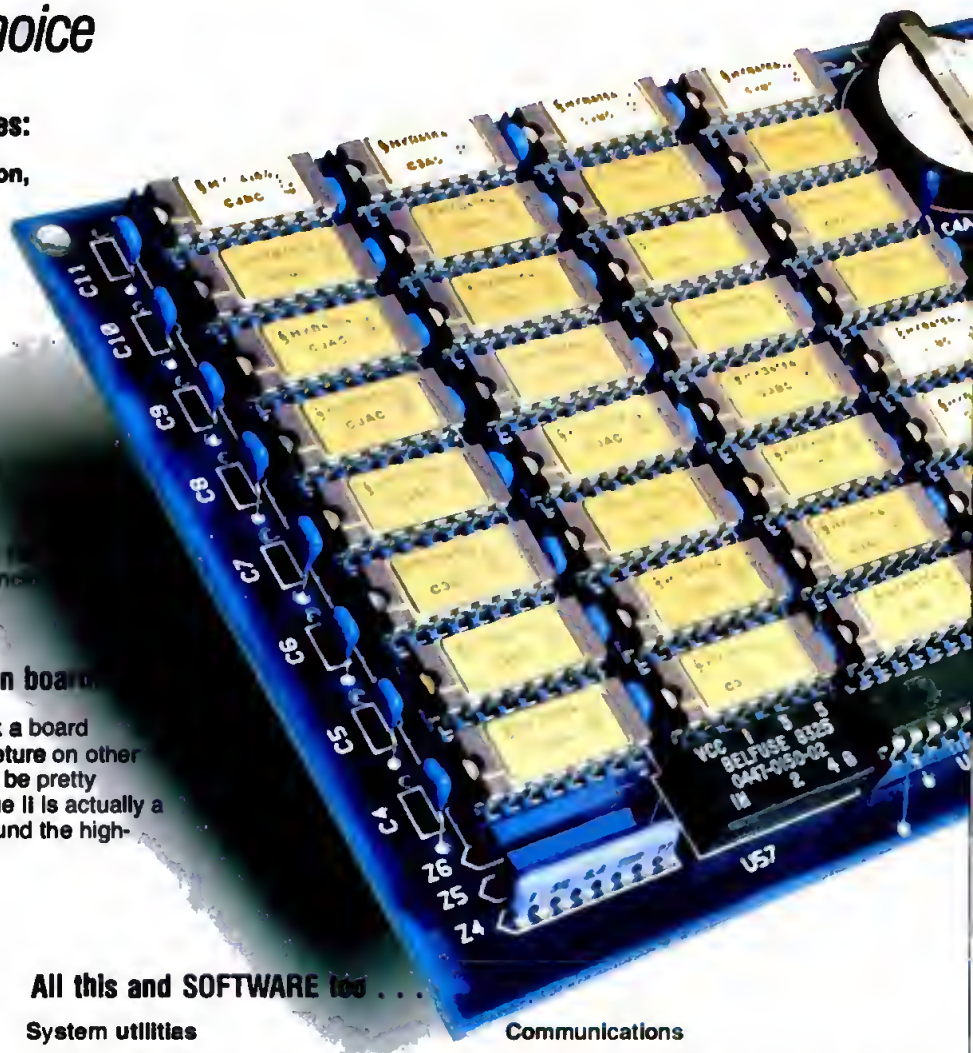

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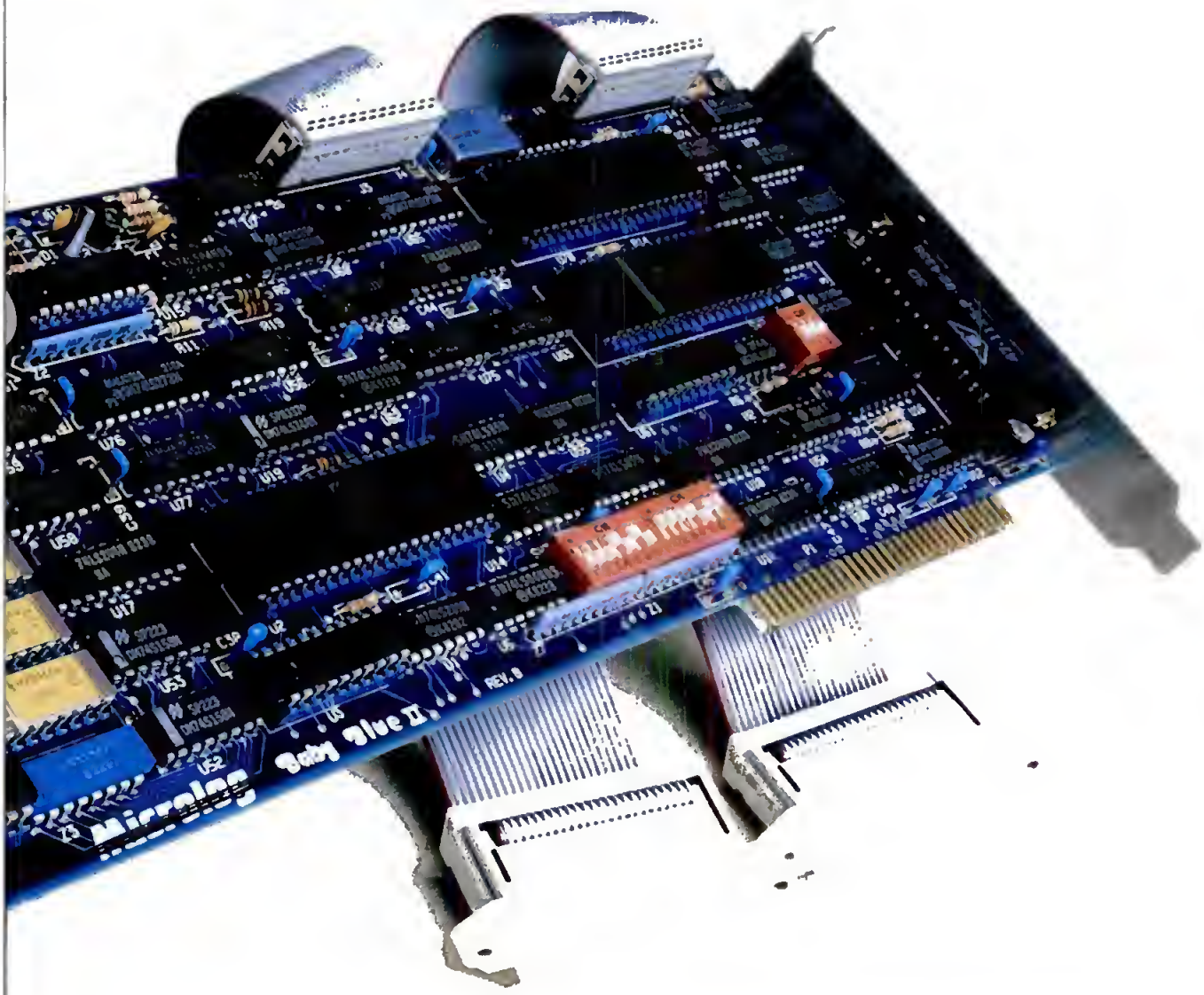

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The PC Compatibility Test

How to tell if the computer you just bought is an IBM PC, a PC compatible, or just visiting. Use this guide to achieve better relationships with the electronics in your life.

Some days you'd think we're running a marriage counseling service around here. Every other call or letter comes from some poor, desperate soul who wants to know whether his or her computer is—compatible.

Ah, yes, the marriage between user and machine is often a rocky path, strewn with magnetic maladjustment, silicon strife, and disk drive delinquency. I tell you, it can get downright depressing counseling the unhappy holders of these shattered dreams of PC compatibility.

And so, as a public service, I am pleased to publish the First Annual PC Compatibility Test. Just sit down and fill out the following questionnaire. Better use a pencil and paper—it's more impartial. And be honest, now.

1. What operating system does your computer use?
   a) Gregg shorthand
   b) MS-DOS 18.623
   c) None available yet
   d) PC-DOS from a beige binder in a gray slipcase

Here's how to score each answer:
   a) What if you break a fingernail? No points.
   b) Have they gotten out the bugs yet? You lose 3 points.
   c) Why was that salesperson smiling? You lose 5 points.
   d) Sounds Blue to me. Give yourself 3.

Corey Sandler

2. How many keys does it have?
   a) Two, one for the doors and one for the trunk
   b) 83, but not in the right places
   c) 83, but rearranged in a logical manner
   d) 88

Score for each answer:
   a) Home, James. No points.
   b) Must be the real thing. You get 3 points.
   c) A cheap imitation, no doubt. Subtract 3 points.
   d) Have you had it tuned lately? You lose 5 points.

3. What movie stars do the company's advertisements imitate?
   a) Buster Keaton
   b) Diane Keaton
   c) Charlie Chaplin
   d) Charlie the Tuna

Score for each answer:
   a) Cute, but the wrong studio. Take away 3 points.
   b) Cute, but no points.
   c) The little tramp. Give yourself 3 points.
   d) Sounds fishy to me. Subtract 5.

4. How much does a fully configured system cost?
   a) Too much
   b) Too little
   c) Just right
   d) It's free with the purchase of $5,000 worth of *PacMan* games

Score for each answer:
   a) Yes, but. . . . You get 3 points.
   b) Will it hold down the papers on your desk when the wind blows through the open window? 3 points blow away.
   c) Too little. Give up 5 points.
   d) You've still got to stock up on quarters. No points.

5. What color shirts do the company's

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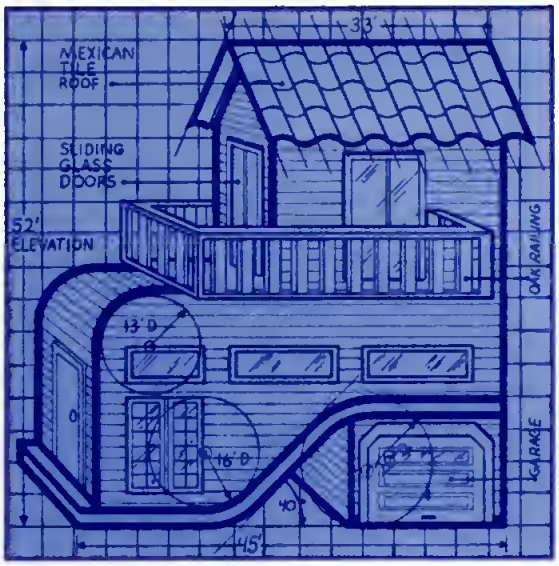

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SANDLER'S SCREEN

salespeople wear?
a) White
b) White on white
c) Orange and green paisley
d) Blue

Score for each answer:
a) Is there any other color? Give yourself 3 more.
b) They're trying too hard. No points.
c) It probably clashes with the yellow plastic pen holder. Pay 5 points.
d) Poor judgment, but tastefully done. You give up only 3 points.

6. Where is the manufacturer's headquarters?
a) Turkey Grove, Tennessee
b) Osaka, Japan
c) Boca Raton, Florida
d) Mus Musculus, Minnesota

Score for each answer:
a) Cute. Lose 3 points.
b) Not funny. Lose 5 points.
c) Be it ever so humble. Give yourself 3 points.
d) Strictly Mickey Mouse. No points.

7. When will it be delivered?
a) Tuesday.
b) A year from Tuesday.
c) A week ago Tuesday.
d) As soon as the boss gets back from Bermuda.

Score for each answer:
a) Too soon. Return 3 points.
b) What's your hurry? Got work to do? You get 3 points for waiting.
c) When will your CPU arrive? No points.
d) But you get burned. And you give up 5 points.

8. What size disks does it use?
a) 3¼-inch.
b) 5¼-inch.
c) Large economy size.
d) 5-inch.

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   - ☐19. Data Base Administrator
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   - ☐24. Systems Engineer
   - ☐25. Design/Production/Research Engineer
   - ☐26. Consultant
   - ☐27. Educator
   - ☐28. If your title is other than above, what is your title? _____ (Please be specific)
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- ☐D. Approve purchase
- ☐E. Acquire them
- ☐F. Other involvement _____
- ☐G. No involvement

8. **The *Personal (Micro) Computers* purchased for this location would be:**
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  - ☐G. Time Billing
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- ☐ 3. Data Base Management
- ☐ 4. Data Input/Analysis
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How good a manager are you? Thoughtware Module 1.1 "Assessing Personal Management Skills" will tell you. This program is a three-part, comprehensive self-assessment of your personal attitudes, behavior and understanding as they relate to your effectiveness as a manager.

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To introduce you to Thoughtware, we'll send you "Assessing Personal Management Skills" (which normally sells for $350), for only $150. (See adjacent column for details.) *Offer expires April 30, 1984.*

Thoughtware programs run on the following: IBM® PC, PC XT, PCjr and compatible PC's. Apple® II Plus and IIe.

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CIRCLE 424 ON READER SERVICE CARD

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Thoughtware Inc.
Suite B, 2699 So. Bayshore Dr.
Coconut Grove, Florida 33133.

SANDLER'S SCREEN

Score for each answer:
a) Don't you feel small? No points.
b) Slip me a disk, Jackson. And 3 points.
c) Each box comes with a free towel. But it costs 3 points.
d) You can always trim a quarter-inch off *WordStar*. Subtract 5 points.

9. How do you get service?
a) By tipping the head waiter 5 bucks.
b) By taking all foreign parts out of the machine and polishing to remove fingerprints.
c) You don't.
d) By calling the service person.

Score for each answer:
a) It costs 5 points, too.
b) You lose 5 hours, but gain 3 points.
c) Don't break it. And you're out 3 points.
d) Not compatible. No points.

10. Can it play *Flight Simulator?*
a) No, but if you hum a few bars it'll fake it
b) It gives new meaning to the term *disk crash*
c) It won't even run BASIC
d) It *is* a flight simulator

Score for each answer:
a) Can it play "Far, far away?" You lose three points.
b) Coffee, tea, or PC? Serve yourself 3 points.
c) What's BASIC? Subtract 5 points.
d) Take a dive. But don't take any points.

11. When you let your fingers tiptoe across the keys:
a) It sounds like a broken-down '59 Edsel with 400 pounds of rock salt in the trunk, slipping sideways across a typical New Jersey Transit railroad crossing.
b) It feels like you are typing on fresh fruitcake.
c) It plays "Far, far away."
d) They trip over your thumbs.

Score for each answer:
a) The hills are alive with the sound of (Blue) music, and 3 more points.
b) This is another fine mess you've gotten us into, Ollie. I'm taking away 5 points.
c) The hills are alive with the sound of Muzak. Spend 3 points on earplugs.
d) Have you tried typing with mittens? No points.

12. Can you plug in a multi-function board with 512K of RAM, a clock/calendar, two parallel ports, three serial ports, a game adapter, and a windmill?
a) Yes, but they won't work.
b) Yes, but you have to wind the clock twice a day.
c) No
d) Yes, but don't tell IBM.

Score for each answer:
a) Congratulations. Your machine is the winner of the Academy award for best actor in a non-supporting role. But no points.
b) Don't worry: the parallel ports are convex anyway. Forfeit 3 points.
c) Oh. You have to give back 5 points, too.
d) So don't tell them. Gain 3 points.

How to compute your final score:
1) Total up your points.
2) Multiply this figure by your machine's baud rate.
3) Subtract the amount remaining in your checking account.
4) Throw away the results.

A final question: Does your computer do the work you want it to?
a) Yes
b) No

Therefore:
a) It's compatible.
b) It's not compatible. ■

FilePlan. Orga
a spreadsheet organ

Here's the first electronic filing system that lets you see the big picture. On the IBM PC and most personal computers.

Like a spreadsheet, FilePlan™ puts data in rows and columns. You can scroll over your entire worksheet to see everything.

Type in any information you need to file and update—customer lists, expense records, addresses, projects due, personnel records, purchase orders.

It's easy because FilePlan works like you think. You don't have to set up a program. Just plunk in the data, *then* decide how you want to sort it, update it, retrieve it, combine it, display it on the screen and print it out. A menu of actions is always available. Help is a keystroke away.

If you'd rather see one entry at a time, just flip into "forms" mode. You can enter data either way.

The information is totally under your control.

Say you've made a file of customer orders with amounts and dates. FilePlan will automatically re-sort the list with every entry.

Then, before your next trip to Cleveland, you can:

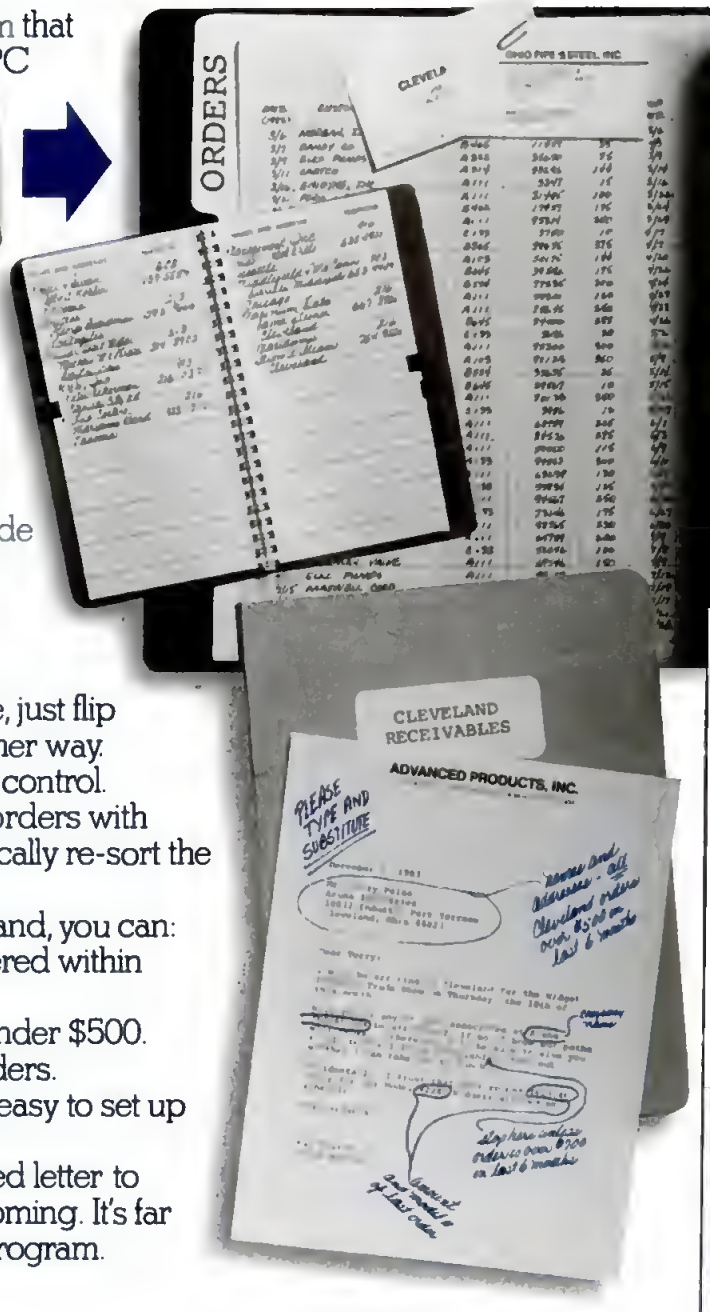
List everyone in Cleveland who ordered within the last six months.

Exclude anyone whose order was under $500.

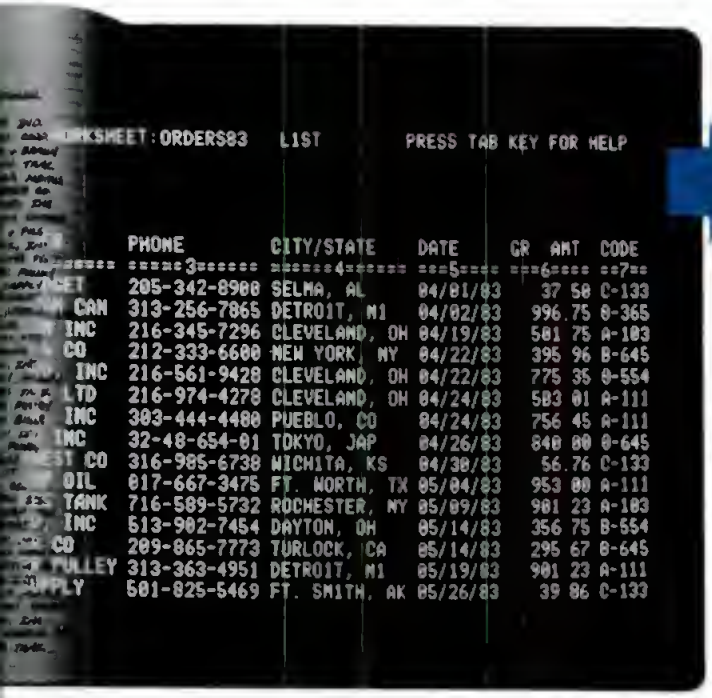
Rank the customers by their total orders.

Print out mailing labels. Formats are easy to set up with MemoPlan™ or any word processor.

Have FilePlan generate a personalized letter to special customers so they know you're coming. It's far easier than using a typical "mail merge" program.



nizes your files like izes your numbers.



That's just a start. FilePlan eliminates most mistakes—or helps you correct them. If you forgot to include a category or need more room for a field, you can make changes any time. For someone who's inexperienced at data entry, just specify prompts and limit the kind of data allowed—for instance, nothing except five numerals under "zip code."

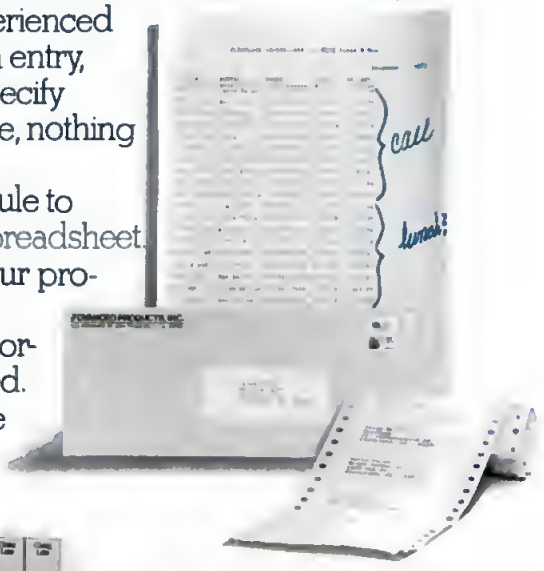
FilePlan even transfers data through our Link Module to MicroPlan,™ Chang Labs' renowned financial planning spreadsheet.

You can pull sales figures from FilePlan, then do your projections with MicroPlan.

Just about anything you can imagine doing with information, FilePlan will do for you. Easier than you imagined.

See for yourself. There's a dealer nearby who'll give you a demonstration.

Chang Labs, 5300 Stevens Creek Boulevard, San Jose, CA 95129. (408) 246-8020.



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CIRCLE 238 ON READER SERVICE CARD

Apple II | CP/M | IBM PC

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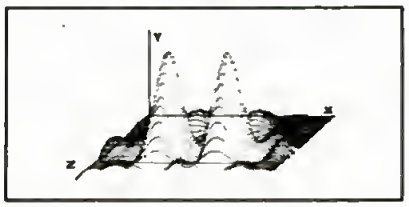

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  - Account Listings
  - Customer Balances

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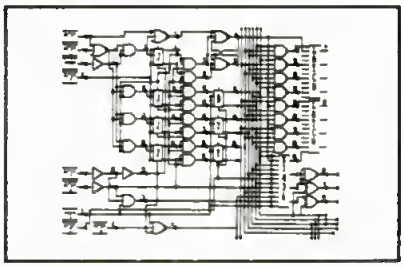
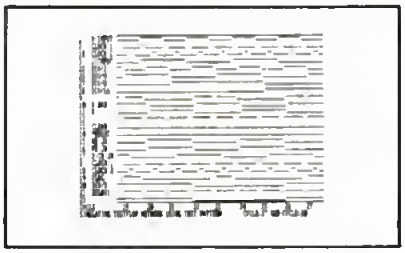
An interactive graphics program for designing and simulating digital logic systems. Using the built-in graphics module, the user creates a logic diagram consisting of AND, OR, NAND NOR EX-OR D T JK FLIP FLOP and powerful 16 pin user-defined MACRO functions. A typical page of a logic diagram looks like this:



The system provides on-screen editors for NETWORKS/MACROS DATA CHANNELS, CLOCK WAVEFORMS and GATES. GATE attributes include DELAY, TRUTH TABLE, NAME and I/O clocking



The system is available for Apple II and IBM PC computers. A non-graphics version is available for CP/M 2.2. It uses the network editor to create netlists and text printer plots to display simulation results. All versions require 2- 5 1/4" disk drives

For APPLE II, IBM PC (192K) and CP/M (70K) $450.00
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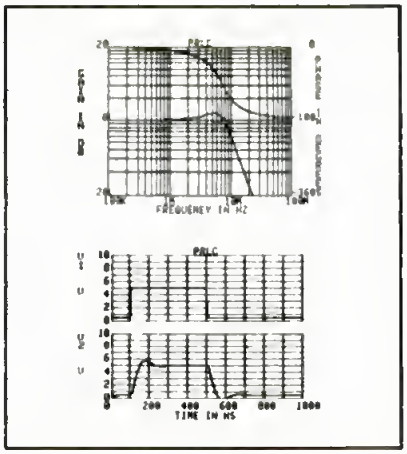

For APPLE II and IBM PC computers. A non-graphics version using an on-screen editor to enter networks and text printer plots to display simulation results is available for CP/M (2.2- 5 1/4" SSSD) systems. Requires 2 disk drives

For APPLE II, IBM PC (192K) and CP/M (70K) $475.00
MANUAL and DEMO DISKETTE $50.00

ORDERING INSTRUCTIONS: All programs are supplied on disk and run on Apple II (64K) or IBM PC (128K) with a single disk drive unless otherwise noted. Detailed instructions included. Orders are shipped within 5 days. Card users include card number. Add $2.50 postage and handling with each order. California residents add 6 1/2% sales tax. Foreign orders add $5.00 postage and handling per product.

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Greek And Egyptian Adventures

Two excellent new adventure games, Ulysses and the Golden Fleece and Infidel, may keep you spellbound for months and months as you attempt to unravel their intricacies.

The French writer André Gide once said: "It is only in adventure that some people succeed in knowing themselves, in finding themselves." Although the games reviewed here, *Infidel* and *Ulysses and the Golden Fleece*, are simulations rather than actual adventures, having played them, I can honestly say that I know myself better—although I wish I didn't.

The spell of these adventures is so powerful that I gladly gave up rest, food, and companionship to spend more time at the keyboard. But despite the hours I've put in, I still don't know whether I'm anywhere near the end of either game.

Both games are well designed, challenging, and a lot of fun to play. They also represent the two major types of adventure games. *Infidel* is pure text. It gives you a lot of written detail, but leaves the visual up to your imagination. *Ulysses and the Golden Fleece* is a graphic and text adventure, which uses a high-resolution picture for each scene, with short text.

Infidel
Infocom, Inc.
55 Wheeler St.
Cambridge, MA 02138
(617) 492-1031
List Price: $49.95.
Requires: 48K RAM, one disk drive.

CIRCLE 746 ON READER SERVICE CARD

A six-page, handwritten diary and an unfinished four-page letter on stationery from the Hotel Americain in El Menhir, Egypt, set the stage for *Infidel*, a modern day archaeological adventure. These preliminary materials explain the predicament that you will soon find yourself in.

Once you've booted the game, you'll discover that, as the unsung assistant of a successful archaeologist, you have gotten a lucky break. A woman whose father came close to unearthing the last great pyramid has given you his map, some hieroglyphic drawings, and a partial hieroglyph dictionary. She has financed your expedition to the Egyptian desert.

Your goal is to locate and enter the lost pyramid, explore the rooms, solve the puzzles, and acquire enough information to find the sarcophagus.

Shown above is a screen from Sierra On-Line's *Ulysses and the Golden Fleece*. You must enter commands to advance through the game.

Hayes™

Your computer's telephone.

What will counteract NDC 74-0054-60?

Gary: The pedigrees for next week's auction are as follows...

Sold 1000 shares at 33 for net profit of 6000. Richard.

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Choose your speed; choose your price. The lower-priced Smartmodem 300 is ideal for local data swaps and communicates at 300 bps. For longer distance and larger volumes, Smartmodem 1200 operates at baud rates of 300 or 1200, with a built-in selector that automatically detects transmission speeds.

Both work with rotary dials, Touch-Tone® and key-set systems; connect to most time-sharing systems; and feature an audio speaker.

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Smartcom II. We spent a lot of time developing it, so you can spend less time using it. Smartcom II prompts you in the simple steps required to create, send, receive, display, list, name and re-name files. It even receives data completely unattended—especially helpful when you're sending work from home to the office, or vice versa.

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Smartmodem 1200B (Includes telephooe cable. No serial card or separate power source is needed.)

Smartcom II communications software.

NOTE: Smartmodem 1200B may also be installed in the IBM Personal Computer XT or the Expansion Unit. In those units, another board installed in the slot to the immediate right of the Smartmodem 1200B may not clear the modem; also, the brackets may not fit properly. If this occurs, the slot to the right of the modem should be left empty.

And, in addition to the IBM PC, Smartcom II is also available for the DEC Rainbow™ 100, Xerox 820-II,™ and Kaypro II™ personal computers.

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CIRCLE 303 ON READER SERVICE CARD

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As the diary makes clear, things went downhill from the moment you entered Egypt. First, the navigation box you need to locate the buried pyramid site falls off a truck and breaks. Your workers don't really like or respect you, especially when you try to make them work on a holy day.

Abdul and the boys poison your kouniss (a drink made from fermented mare's milk), clean out the camp, and leave you, a worthless infidel, for dead.

The game begins with on-screen text that describes you waking up, groggy and all alone on the cot in your tent, to the sound of the desert winds. Then, in the distance you hear a plane. Like manna from heaven, it drops a crate by parachute—the long awaited replacement navigation box.

Of course, you're going to need much more than the box to stave off death from hunger, thirst, and heat. Most of what you'll need can be found in the 16 scenes that map the square encampment. (Be sure to draw your own map to chart your progress and detail important items.) You will need water, something to carry it in, some food, and a shovel, of course. Unfortunately, Abdul and the boys have nearly stripped the camp of useful items; those that remain are hidden or locked inside your own footlocker, and Abdul has taken the key.

Once you figure out how to find half a dozen items in camp, you'll probably head into the desert at random. Don't. Remember: It's about 106 degrees in the shade, and there's no shade anyway. The map that comes with the game shows a mark where a cube containing hieroglyphs was found circa 1920. If you have the cube itself, use the navigation box to get to that mark, then think for a few minutes.

The buried pyramid, if you find it, is huge, with enough chambers, secret passages, treasures, and pitfalls to keep you hunting for months. Along the way you will probably find a lot of hieroglyphs, and it is a good idea compile a "dictionary" of them. You must solve their meanings to solve the game. You use the keyboard to input your commands and make your moves, which are limited to eight compass directions in addition to up, down, in, and out. The real beauty of *Infidel* is the breadth of its vocabulary (over 600 words) and its ability to understand full sentence commands with adjectives, rather than mere two-word noun-verb sentences.

This "interlogic development system" also permits the game to string two separate commands into a single sentence, which speeds up the game. For instance, you can enter a command such as: Walk up the Winding Stairway, Then Drop the Shovel in the Doorway. If your PC does not understand a sentence or a particular word, it will tell you so and give you a chance to try synonyms. Some of the words the game understands are given in the manual—which is written in the style of an adventure magazine—but the majority of useful words are left for you to discover. *Infidel* requires common sense, logic, intuition, and often trial-and-error.

My best advice is to explore and examine everything you see or suspect you might see and not to overlook the obvious. It's also a great idea to save your position in the game to a blank disk just before exploring dangerous options. Then, if you die, you can reload your saved position and try something else. If you really get stuck, you can write for playing hints to Infocom's fictitious "sanity insurance" company, Bilk & Wheedle.

Michael Berlyn, author of the critically acclaimed *Suspended*, wrote *Infidel*. His prose style is exciting and fast-paced, with occasional bits of humor. And most of what you read accurately represents ancient Egypt, using research by Patricia Fogleman, a Harvard graduate student.

On *PC*'s scale of one to six, *Infidel* rates:

FUN:	6
CHALLENGE:	6
GRAPHICS/SOUND:	0
(not applicable)	
TOTAL SCORE:	12

(continued)

Ulysses and the Golden Fleece
Sierra On-Line, Inc.
36575 Mudge Ranch Rd.
Coarsegold, CA 93614
(209) 683-6858
List Price: $32.95.
Requires: 64K RAM, one disk drive, color/graphics adapter.

CIRCLE 745 ON READER SERVICE CARD

Those of you who remember your Greek mythology are surprised, I'm sure, by the title of this game. After all, it was Jason and the Argonauts, not Ulysses, who sought the Golden Fleece. But since Columbia Pictures has already chronicled that story as a motion picture, Sierra wanted no part of any copyright problem. So Bob Davis, coauthor of the game with Ken Williams, wrote Ulysses into the part.

As Ulysses, the object of your quest is the Golden Fleece, which is guarded by fearsome beasts on an island far away from your homeland. You must gather all the provisions you will need to survive a long and perilous sea voyage, find and hire a crew of sailors (with money you get from the King, along with his permission to go), sail to the Island of Storms, obtain magical items to help you capture the Fleece, set sail again for Colossal Island, find the Fleece, battle its protectors, and return home with it. Heros never have it easy.

Unlike *Infidel*, *Ulysses and the Golden Fleece* uses graphics as well as text to describe and act out each scene. The text is much less descriptive than that of *Infidel* because the illustrations contains information, too. Not everything you need to know is in the text. Sometimes you must look for a clue in the picture. The game has only a four-line text window at the bottom of the screen. (When there are more than four lines, pressing the Scroll-Lock key brings them up.)

The object of your quest is the Golden Fleece, which is guarded by beasts on an island far from your homeland.

Like *Infidel*, you enter commands via the keyboard, but they are limited to two-word noun-verb sentences such as, Go Store, Get Key or Look Road. The vocab-

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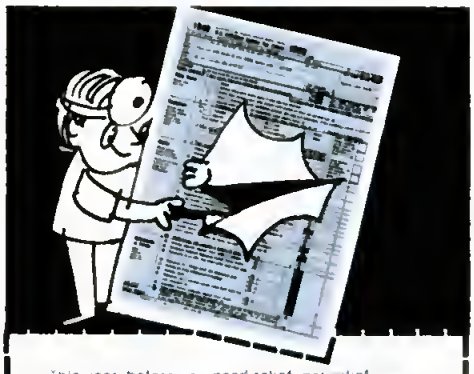
SCH B	2106	4797
SCH C	2119	4835
SCH D	2210	5695
SCH E	2440	6251
SCH ES	2441	6252
SCH F	3468	DATA/INSTR



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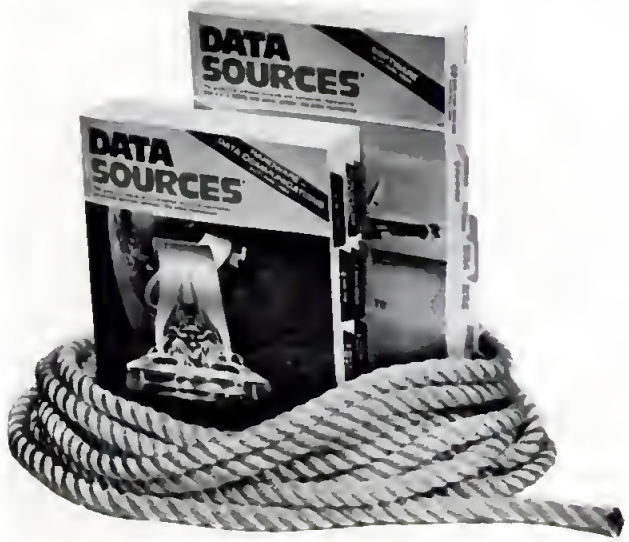

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PC ARCADE

ulary is obviously limited. These are the trade-offs for the gorgeous graphics.

You can only move your party from one scene to another in six directions: north, south, east, west, up, and down. To take an action from within a scene, you must use the simplest command to the computer. For example, Go House, which means you want to enter a house. But don't try only those things that are possible in real life because logic is not always the stuff of mythology. Perhaps you can fly off a mountain top or dive to the bottom of the ocean. Perhaps not.

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Before playing this game, rereading the story of Jason and the Golden Fleece, the *Iliad* and the *Odyssey*, and any other Greek mythology will be helpful and rewarding. These stories will yield many clever ploys that can—say—get you out of the Sirens' clutches.

Even so, coauthor Bob Davis says that a good adventurer working 24 hours a day would need a couple of weeks to recapture the Fleece, which means that the game is quite likely to remain on your "actively played" shelf for the better part of a year.

On *PC*'s scale of one to six, *Ulysses and the Golden Fleece* rates:

FUN:	5.0
CHALLENGE:	6.0
GRAPHICS/SOUND:	3.0
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TOTAL SCORE:	14.0

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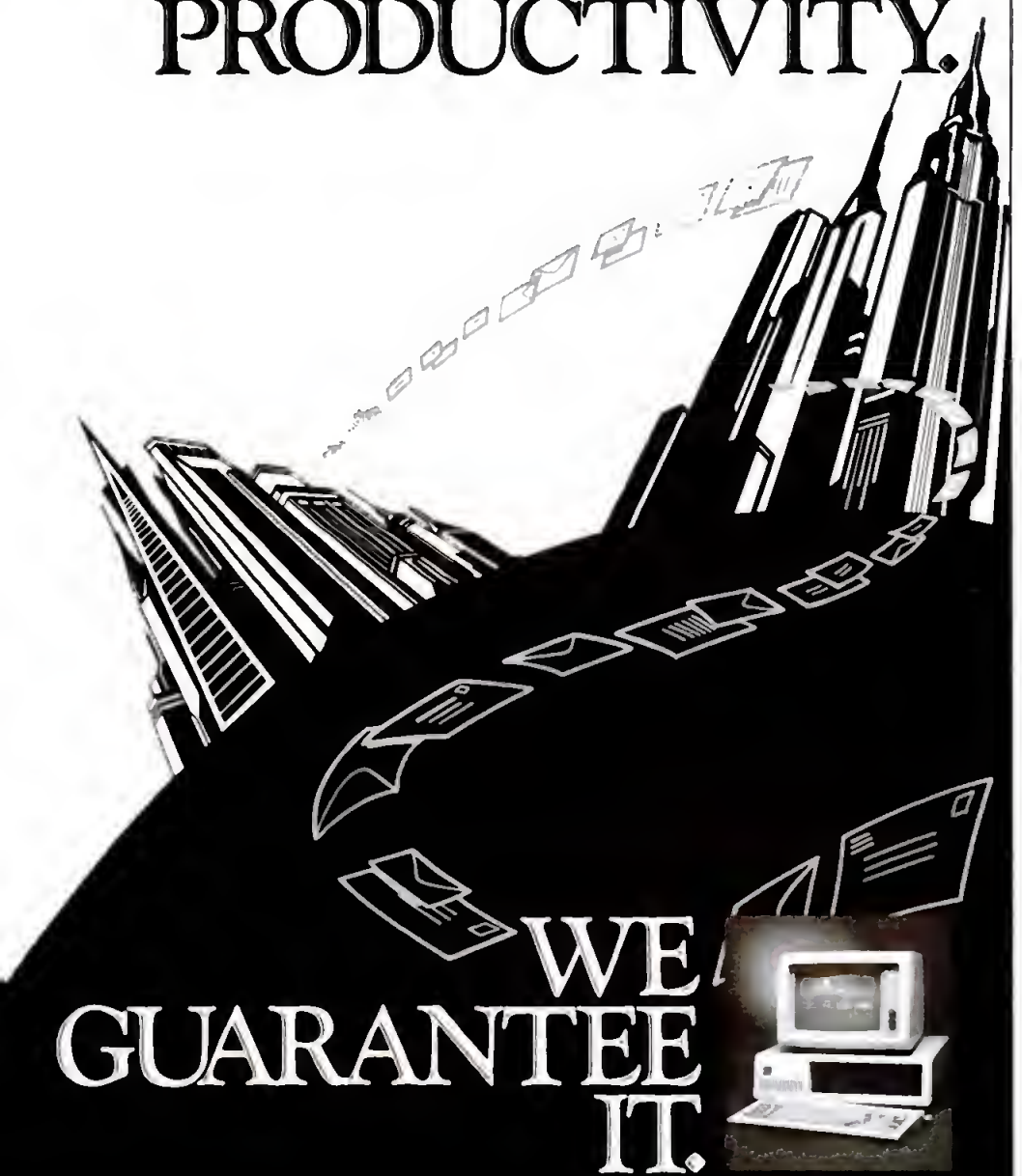

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Help For Experts And Novices

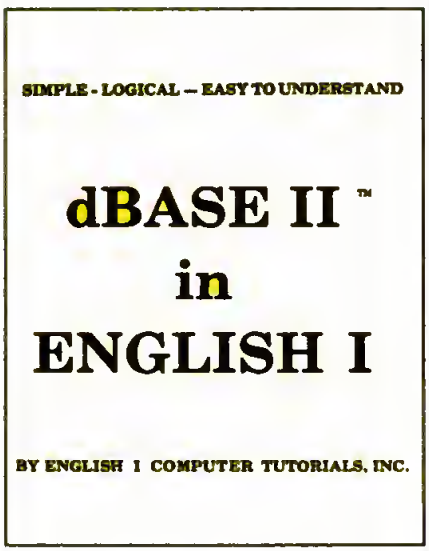
Here is a disappointing stab at making dBASE II easier to learn, and a more successful guide for women who want to overcome their fear of computers and learn about this new technology.

Ashton-Tate's wonder database management program, *dBASE II*, has never been easy to learn. Ashton-Tate provides two manuals with its software, and it is tacitly understood that to master the intricacies of *dBASE II*, one must expend considerable time and energy sweating out the often incomprehensible explanations of its various functions, expressions, and commands. Few users can afford to devote so much time and effort to a program. For many, the subtleties of *dBASE II*, including the difference between commands such as ELSE and OTHERWISE, ACCEPT and INPUT, or FIND and LOCATE, simply have had to remain beyond understanding.

Along come Larry and Steven Doroff, a father-and-son team in northern Illinois who, when faced with Ashton-Tate's official rite of initiation into *dBASE II*, decided to make things a little easier for the rest of us. Basically, they attempted to translate the *dBASE II* manuals into commonsense, straightfoward English. For their effort (if not for the resulting book), they deserve applause.

dBASE II in English I
Steven and Larry Doroff
(English 1 Tutorials, Inc., Chicago, IL 1983)
233 pages, paperback, $29.95

CIRCLE 719 ON READER SERVICE CARD



Unprofessional Execution

Carrying their efforts a bit further, the Doroffs went on to publish the book themselves. The final product—a bright yellow, oversized paperback proudly claiming to be "perhaps the finest computer book ever written"—falls (at least in the edition reviewed here) far short of its promise. It turns out to be about as professional a publication as the mimeographed high school newspaper I once worked for. The idea behind this book is a fine testament to the entrepreneurial spirit that makes the computer industry such a joy to work in. Too bad the realization of this idea misses its mark entirely.

dBASE II in English I can teach you enough of how *dBASE II* works to create and play with the databases used as examples therein. Along the way, however, you end up learning some programming practices that—as Ashton-Tate and numerous authors of other *dBASE II* tutorials point out—are best avoided. For example, the book claims that LOOP commands are part and parcel of DO WHILE command files, something that can lead a new *dBASE II* user into overuse of this possibly troublesome command. The first time I used LOOP I caused a command file to endlessly copy the same data over and over again to a new file, while it also destroyed the original. So much for LOOPs.

Another exercise in *dBASE II in English I* has the reader learning how to alter fields in an existing database. This bit of knowledge is necessary to modify a database to which you've already entered data (something every *dBASE II* user ends up doing at one time or another). Following the guidelines laid out here, you copy your data to a TEMP file (though Ashton-Tate tells you it's best to copy just the *structure* of your database to TEMP, leaving your original database in pristine condition should something go wrong). Then, (without verifying that your TEMP file is exactly the same as your original), the

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book instructs you to go back to your original and modify its structure.

The Doroffs do point out that by using the MODIFY STRUCTURE command on your original file, you lose all of the data in that file. So what, it's all safe in the TEMP file. They ask, "We know what we're doing, right?"

The logic of the procedure outlined above escapes me. Since *dBASE II* allows you to modify an empty TEMP file and then copy your data into it when it's exactly as you want it, why should you destroy your original? Stick with the procedures laid out in the Ashton-Tate manual. Destroying your files should be done intentionally and deliberately, not just because you want to change a field's name to something you like better (a common reason for modifying databases).

In less technical areas, I found the book's attempt to be chummy and colloquial infuriating, as it often led to just plain bad writing. About a third of the way through the book, the copy editor in me gave up shouting "Syntax Error," but

You end up with a book almost as maddening to read as the horrible software manuals it promised to supplant.

only out of sheer exhaustion. Add just about every conceivable typographical error (especially in the latter half of the book), and you end up with a book almost as maddening to read as the horrible software manuals it promised to supplant.

Hope Springs Eternal

Having already expended so much effort on this potentially great project, perhaps the author/publishers will go back and polish their work. I'm told the second edition eliminates most (if not all) of the typos. Maybe the third will correct the syntax, the fourth the misleading instructions, and so on.

All problems aside, the original concept of the book is great. The world truly needs an understandable, comprehensive guide to *dBASE II*. However, in its current form, this $30 book just ain't it. —D.O.

Computer Confidence: A Woman's Guide
Dorothy Heller and June Bower
(Acropolis Books Ltd., Washington, DC, 1983)
256 pages; $16.95 hardcover, $9.95 paperback

CIRCLE 718 ON READER SERVICE CARD

Another title for *Computer Confidence: A Woman's Guide* by Dorothy Heller and June Bower might be "all you ever wanted to know about computers, but were too phobic to ask." It's a good first introduction for the complete novice. It is well written and provides enough information to enable the reader to explore the field on her own.

Although men could benefit from some of the information in the book, it is geared toward the businesswoman, educator, or parent who feels she (or her children) might benefit from using computers. It covers methods for overcoming fear of computers; case histories of women who overcame that fear; the history of computers; examples of applications; definitions of computer "buzzwords"; shopping tips for purchasing hardware, software, including children's programs; a discussion of different types of computer careers; and computer job hunting tips.

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BOOK REVIEW

fears. One drill asks the reader to list her anxieties about computer use, and also to list the tools and technology with which she is already familiar (such as office equipment). Many readers will discover that they're more comfortable with technology than they think.

The most useful sections of the guide are the brief introduction to computer systems, the glossary of computer terminology, and the "Smart Shopper Guide."

The shopping guide offers the novice a good idea of the different kinds of retail computer outlets, which include independent retailers, chains and franchises, department stores, and mass merchandisers. It discusses the inevitable trade-offs between price and service. Independent retailers are more likely to offer good support for the novice computer buyer, while discount retailers offer low prices, but little support. The guide also details the typical clientele of different kinds of outlets: personal, small business, corporate, or hobbyist.

Software Section

A section on software provides helpful purchasing checklists. One question an inexperienced software purchaser might neglect to ask, for example, is whether a much-promoted software package will work with a particular computer. The pros and cons of various software programs are discussed, as are the advantages of different programming languages. Both hardware and software shopping sections provide worksheets to organize the computer shopper's own research.

For the woman considering a career in computers, *Computer Confidence* describes such careers and gives specific facts about what each position might entail. Finally, Heller and Brown play career counselor and provide job hunting and interviewing tips.

The computer novice is sure to benefit from *Computer Confidence*'s quizzes, charts, and definitions. After reading this book, women may discover a future in computers. **—C.J.G.**

BRIEF REVIEW

Understanding Computers
Donald R. Spencer
(Charles Scribner's Sons,
New York, 1982)
400 pages; paperback; $13.95
ISBN 0-684-18038-3

CIRCLE 535 ON READER SERVICE CARD

Yet another book on the computer basics is *Understanding Computers* by Donald D. Spencer. Classroom discussion questions following each chapter qualify *Understanding Computers* as a textbook, perhaps for junior high school students.

At that level, the book provides a seemingly thorough discussion, although there is one glaring problem in the 1984-released paperback: it fails to mention the IBM PC.

How the material is presented and the writing style also leave a lot to be desired. Take, for example, the definition: "Computer software is comprised of programs and the associated documentation describing them and their operation and the data the programs use." Huh?

Graphically, the book is more successful. The text is laced with cartoons and photos, all of which keep the reader going. Computer applications are described interestingly, and there's also a chapter on computer-related technologies.

The author does a good job of introducing the young reader to the programming process, and there's a chapter on how to program in BASIC.

While the book is suitable for the student with little prior interest in computers (of any kind), it's too mundane for any young person who has caught the slightest glimpse of the fun in computing. The problem is that this book by itself will do nothing to excite these newcomers.

***

Much has been said about the computer taking over our lives, putting people out of jobs, and invading our privacy. These topics cannot be discussed intelligently without knowing more about the computer, but they should be given some thought as your knowledge and understanding increase. Remember that the computer cannot do anything unless it is told what to do by human beings. We should control the computer—it should not control us." ■

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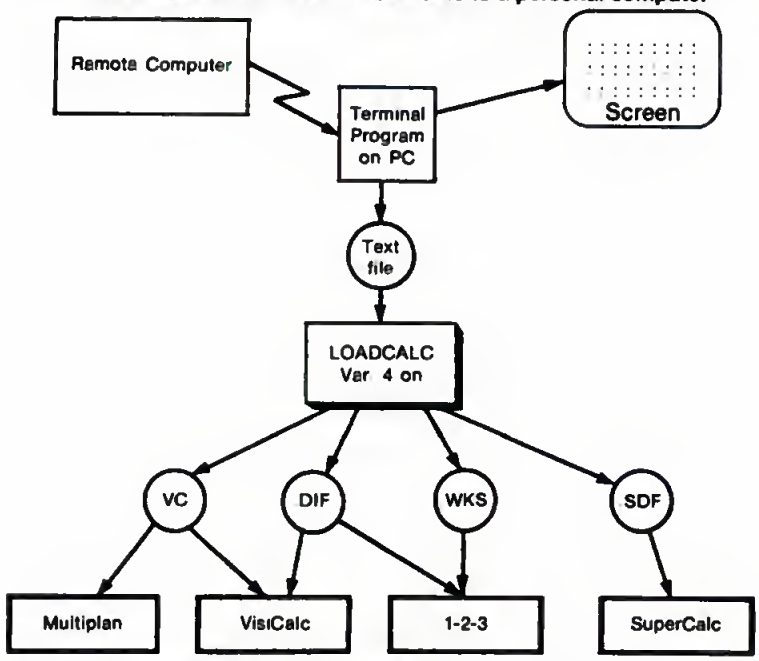
How to transfer data from a mainframe to a personal computer



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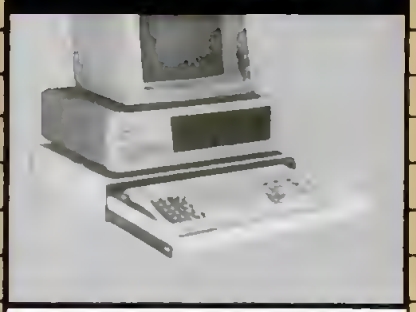

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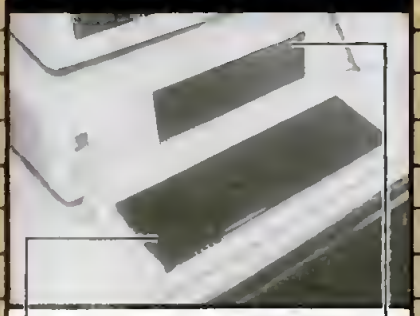

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Getting Organized On Your PC

Word processors process words while databases organize numbers. Both kinds of programs have basic advantages and disadvantages for helping writers organize their notes.

Your PC can help out with complex writing projects before you actually sit down to type a first draft. As an electronic filing clerk and reference desk, your computer can help select, organize, and marshal your information.

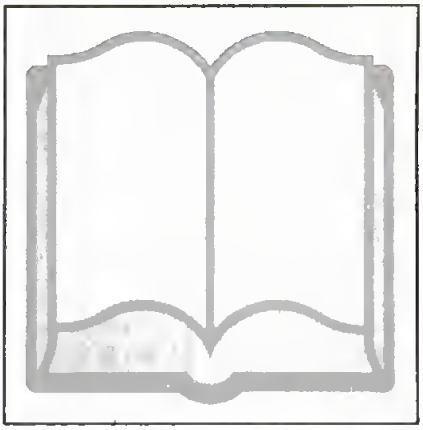
But, even though there are more than 100 different data storage and retrieval programs for the PC, only a few work well for this application. To find the right one for you, look closely at what kinds of information you need to store and what tools are available.

Numbers and Words

Storing the information you need for a writing project is not always a clear-cut proposition. Compared with numeric data, textual information is usually messy: you can't simply take a program meant for saving numbers and use it for text.

Numbers are fairly simple for a program to deal with: they have at least one digit but seldom more than a dozen. When you are allotting space within a program, it is easy to predict how much has to be left for a numeric value. Also, if necessary, you can round off a number to make it fit, and the result is almost always usable.

Textual information, on the other hand, varies greatly in length. Abbreviating or chopping off part of a name or phrase can result in ambiguity in the text. And even alphabetic order becomes complicated



when you consider capitalization, punctuation, hyphenation, and other variables.

Of course, some types of textual information are easier to handle than others. Simple lists, for example, such as those for shopping or telephone numbers, are fairly manageable. On the other hand, a multivolume research report probably requires a more specialized data storage and retrieval system.

In general, textual information causes the fewest problems when the entries are short and independent. Examples are labels for particular events, objects, or people. Accommodating the text is more difficult when the information varies in length and when context is significant.

Word Processors

The easiest way to store the information you need for your writing project is to keep it in a text file on your word processor. You enter the text the same way you type at a typewriter. Using the cursor movement keys, you can insert information anywhere in the text. And to print (or display) the data, you use the normal document-output routines.

If you store small amounts of information and your material is clearly organized from the start, this may be the best method for you. You can edit your notes into a final form. You don't have to worry about the compatibility of different types of files, and you only have to remember one set of operating commands.

There are disadvantages, too. Reorganizing large amounts of information on a word processor can take a lot of time and effort. The program won't help you organize material according to subject matter or any other particular order. And if you want to set up connections between two sets of facts, you have to note that in the text each time the facts are entered.

Some word processing packages are better suited to this application than others. If you collect large amounts of information, you need a word processor that can accommodate lengthy files (one with a virtual memory or a paging system). If you expect to do much rummaging through your files, you'll appreciate one with a flexible search command.

Menu- or command-driven word processing programs execute each command as you enter it. This method can quickly lead to frustration when you need to repeat an operation that is more complicated than a simple word search. For example, *WordStar* has no simple way to say, "Print out all the paragraphs that mention the word *Iowa*. Instead, you have to locate each occurrence, use the block move commands to assemble them, and then print out the result.

You might want to consider using a word processor with a macro feature, which will allow you to write complete routines to search, reorder, or rearrange material according to a specified set of rules. However, programs with this capability merely allow you to do this; they won't do it for you. And writing macros demands the same skill and patience needed to write programs.

Try a Database

Another way to store information is in a database program. These programs are designed for data retrieval, and, at first glance, they might seem to be exactly what you are looking for.

Most database programs for the PC are "relational," which means they consist of a string of records all of the same format, along with a template that defines what each field of the record signifies. You can think of them as row-and-column charts with the labels along the top edge. Each record is a line in the chart with data under each labeled category.

Relational databases are wonderful for clearly defined lists. They are well suited to tasks such as keeping track of employee hours. Packages such as *dBASE II*, *InfoStar*, and *R:base* can keep track of entire disks full of information, print it out in various orders, and select subsets that meet preset criteria.

However, if the information you want to record is not as well behaved, these programs may prove to be too confining. Many databases have structural limitations and lack adequate search facilities.

To use a database, you have to set up the categories in which to file your information. If you want to collect information on international arms shipments, for example, you have to first specify what each entry will consist of (in this case, a sending nation, a receiving nation, the dollar value of the arms, and whether it was a gift or a sale). Later, if you want to add a category defining the type of arms shipped, you would have to restructure your entire database, a process that involves re-reading and rewriting all existing records. Some database programs lack this restructuring ability.

> Some database methods allow you to use several types of variant records.

Further, the overwhelming majority of relational databases offers only fixed-length fields. When you set up the database, you have to specify exactly how much space per record will be allocated for each category. If you need to make an entry longer than the allocated space, you must reorganize the entire file.

You could, of course, simply create your database with large spaces allocated for each category. If you specify 200 spaces for country names, there won't be a problem. Unfortunately, a relational database saves the full length of each field no matter how empty or full it is. If you had two or three fields of 200 characters each, another two or three of 100, and so on, each record might take close to 1,000 bytes of storage. This limits a double-sided disk to about 300 entries.

The other structural limitation of ordinary databases is that every record must be identical. They cannot be changed to fit the information you wish to put in them. For example, if you are collecting information about forms of government, you might want to keep track of the party affiliation of principal legislative officials in a parliamentary democracy but the military rank and branch of service of officers in a military junta. To do this you would have to include all the categories in every record, whether or not they are needed.

Some database methods do allow you to use several types of variant records. For example, the *CODASYL* (hierarchical) model, used for data storage in COBOL and Pascal programs, allows for the definition of various types of records within the same file. Different types of records share some fields but may also have categories that apply only to that type.

Searching . . . Searching . . .

Most standard databases are intended only for text used as a label or element in a list. Generally, databases can print out a field in only one place, the left margin of its assigned position on the page. You get none of the printout flexilibity associated with word processors.

A more serious problem is that most databases can't quickly look through all their stored information to search for a particular entry. Some models let you index the entries, which allows the database to rapidly find entries with indexed fields that match a specified value. But if the information you want hasn't been indexed, you may have to completely re-index the file or have the program search record by record. This can take several minutes.

If your categories allow for long textual entries, you may want to search for a word or phrase that is not the beginning of an entry. However, many database programs search only for matches from the start of each field.

Fortunately, help is on the way. Software developers realize that writers who use the PC need better tools. New programs that create databases organized like card files are now becoming available. For longer text, more notebook programs are expected to join the few already on the market. And, as mass storage for personal computers comes down in price, look for the appearance of mainframe text-processing programs rewritten for the PC. ■

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RISING SPREADSHEET (A) KNOCKS MEXICAN JUMPING BEANS (B) INTO MOUTH OF NEUROTIC MAN (C) WHO IS SO DISCOMBOBULATED THAT HIS HAIR STANDS ON END, DISLODGING HAT (D) WHICH OPENS CAGE (E) AND RELEASES EPICUREAN MOUSE (F).

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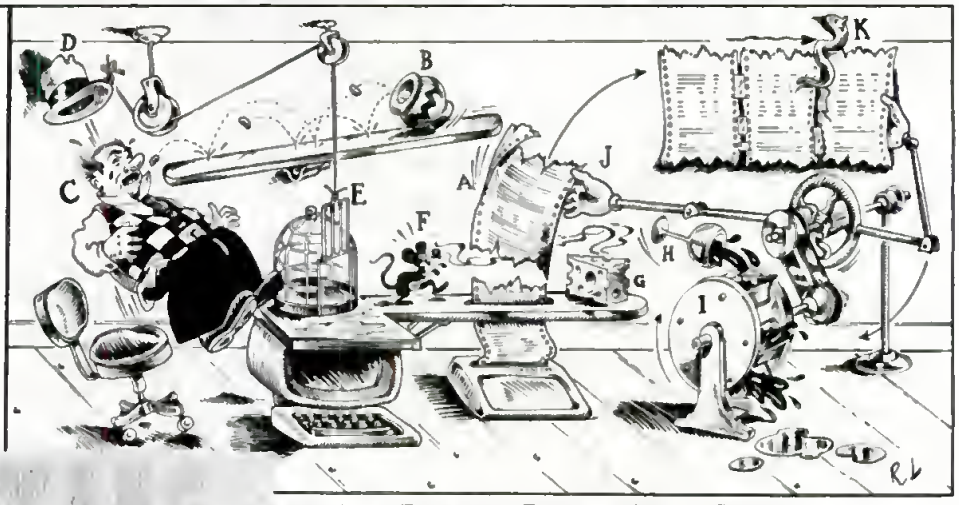

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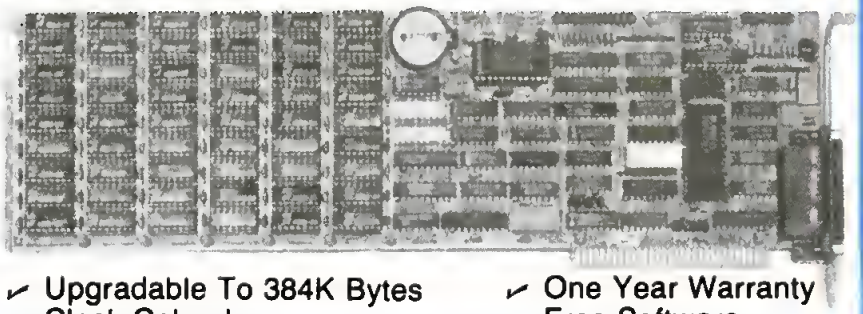

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Exploring Electronic Estimating

The PC is helping contractors calculate estimates to outbid their competitors. This is the second of several articles on how contractors can take advantage of the PC's capabilities.

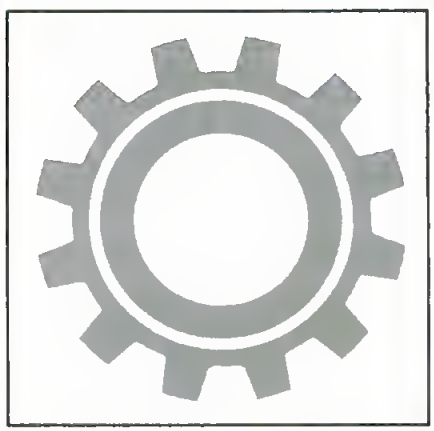
Estimating the cost of a job is a task that many contractors would like to automate. The computerized altemative provides quick, accurate estimates, and converting to such a system is relatively simple. Indeed, computerized estimating is one of the most cost-effective improvements a contracting firm can make.

The number and variety of estimating programs are growing daily, which means good programs are readily available. However, finding the optimum system requires considerable time and effort.

According to former contractor, estimator and present chairman of the Data Processing Committee of the National Association of Home Builders (NAHB), Scott Sloan, "Virtually all estimating systems are worthy of your dollars, but the perfect system for your firm doesn't exist." There's no way to fully replace your manual estimating system with a computer, although a personal computer will cut down the time you spend in estimating a job.

"Additionally, an estimate is more precise when calculated by computers. Cost data is more up to date. Accuracy is a by-product of computerized estimating. Automation gives extra time to recheck costs and omissions, which will help alleviate the normal estimating errors," explains Sloan.

The estimate itself becomes cheaper and easier to obtain. For example, a survey conducted in 1982 of 100 residential home builders revealed that an average manual estimate, which formerly took 16.3 hours, could be completed in 2.8 hours on a computer. In random interviews with other contractors, productivity increases were almost always reported, most often in the 100 to 200 percent range.



In both large and small contracting firms, the IBM PC is helping contractors outbid competing firms that estimate by traditional methods. Automated estimates contain fewer errors and omissions and more up-to-date items and current labor costs. Last-minute cost changes and quotations can be easily added, and the process of balancing or unbalancing a bid is sped up. (Balancing refers to distribution of overhead and profit among the various bid items on the job, while unbalancing refers to unequal distribution of these markups and/or direct costs, as well.)

Types of Estimators

Computerized estimating systems can usually be classified as either "batch" (for estimators who won't interact directly with a computer) or "interactive" (for those who will). According to Herman Holtzman, president of the Autem Corporation, an estimating and scheduling development firm in Madison, Wisconsin, the ideal system is to use the batch method for the bulk of the data and then to permit the estimator to work with a computer to provide further information.

In this column, I'll address only interactive systems. It is possible, however, to use most interactive systems as batch systems, by allowing other operators to enter preliminary data for the estimator, provided the data is submitted on "take-off" forms. (The take-off is the process of determining the various quantities of materials required to perform a project.) This can help speed up the preliminary take-off and item costing. However, since the estimator is still manually coordinating most of the task, a smaller time-savings is realized.

Interactive systems are divided into categories based on degree of intrusion into

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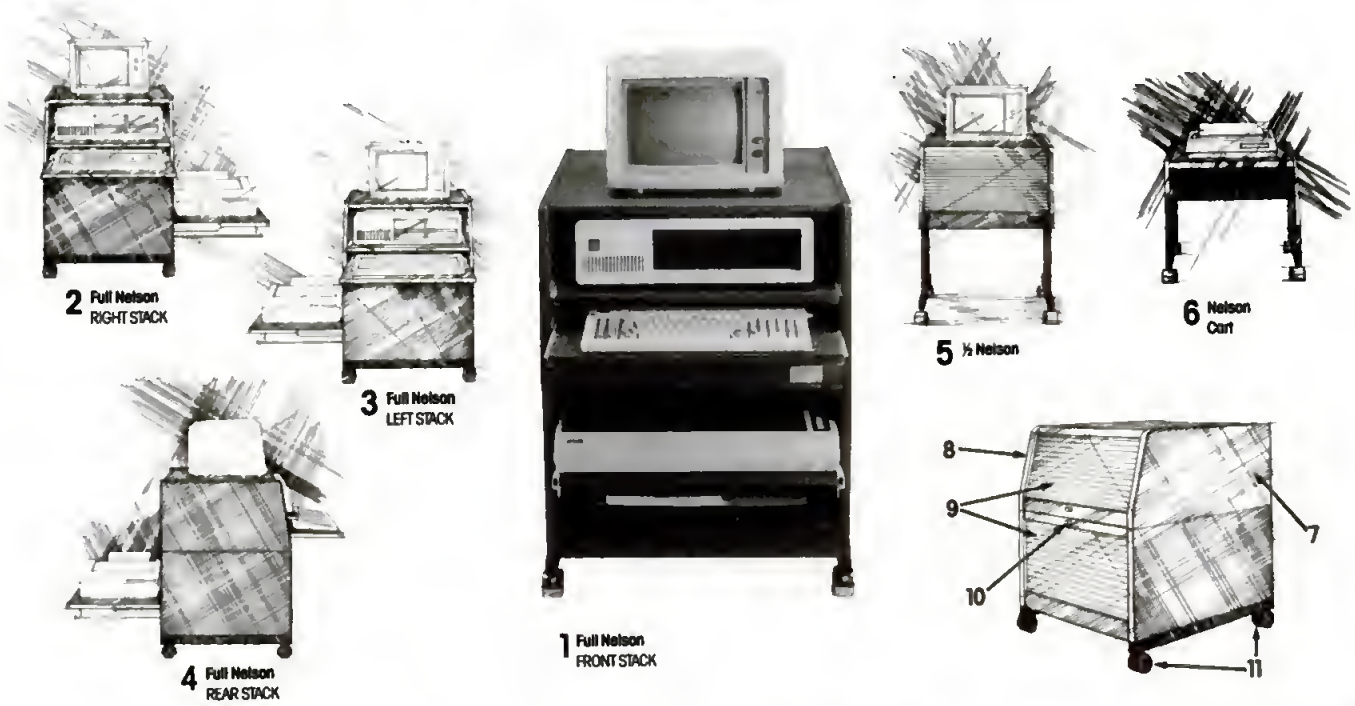

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3 Full Nelson LEFT STACK

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4 Full Nelson REAR STACK

This is the configuration for those with rare and unusual needs. The Nelson not only follows you around, but adapts to any reasonable situation you put it into. Plus, if you have many offices with many separate computers to account for, the Nelson flexibility simplifies your task of fitting computers into multiple space requirements.

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6 Nelson Cart

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7–11 Details, Details, Details.

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And the second hardest decision is whether or not to let the cat out of the bag on how little it actually cost.

12 How about you?

Nelson modularity is designed to let you fit your PC system configuration to your actual space. We, of course, can think of a lot of ways to use a Nelson. But the important way is the one that works for you.

So put on your thinking cap. Planning your office space can be fun. Especially when you know that if you ever change your mind, or expand your requirements, if you're using a Nelson you can always change the furniture you already have to the furniture you need.

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manual methods of estimating. These categories range from a simple electronic spreadsheet program that will run on any popular microcomputer to special-purpose computers specifically designed for estimating.

The Spreadsheet Program

Originally popularized as aids for financial planning, electronic spreadsheet programs have become popular for estimating applications. The estimator could buy an IBM PC, *VisiCalc*, or *1-2-3* and learn to operate the system in a matter of hours. The row-column format allows the estimator to enter data on the computer screen in the same format he would use to enter it on a take-off sheet. Item identification is entered in the leftmost column and detailed descriptions, dimensions, quantities, and extensions are entered across the top row. The computer would then multiply, divide, add, or subtract across the sheet and add the totals down the column.

> The computer is invaluable to the estimator.

This process alone is invaluable to the estimator, because it eliminates the tedious job of entering hundreds of numbers into a calculator, transcribing the results back onto the worksheet, carrying over page totals to the estimate summary sheet, and then making cross totals for different categories of the job. The computer not only eliminates the calculator and transcription steps, but also substantially reduces the margin for error. You don't have to worry about losing your place on the take-off sheet, writing down the results incorrectly, omitting conversion factors, and so forth. Most importantly, changes can be entered, and the estimate can be completely recalculated automatically. Not only is this useful for last minute price changes, but it allows the user to quickly

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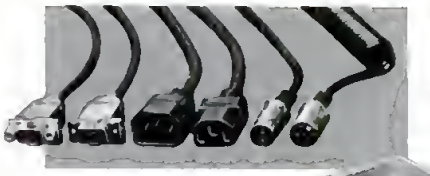

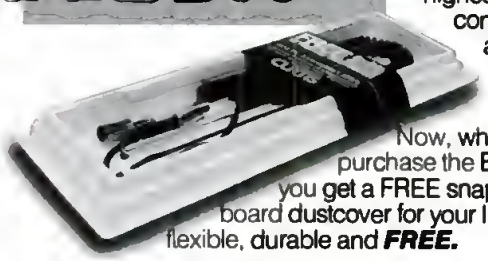

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evaluate alternate materials or methods. Another bonus is the neat, formatted, computer-generated reports, which impress clients. Some contractors believe that this alone is worth the price of the PC. Even the small contractor can make a presentation that is as impressive as that of his larger competitor.

Database Estimating

In spite of its obvious benefits, the usefulness of spreadsheet estimating is usually limited to small estimates and estimate summaries. This is due to the limitations

> A program should produce summaries in a format that is easy to understand.

of the programs and to their inability to store a price file. The greatest advantage of a custom-written estimating software program is that it allows the user to maintain a database of cost items and unit prices. A typical cost file will contain an item identification number, description, unit labor, and/or material price. This way, the estimator does not have to repetitively enter prices for each line item on the take-off.

Some computerized cost-estimating guides are available, too. These save the estimator the trouble of constantly thumbing through the catalog to find prices (if performing a manual estimate) or rekeying a complete guide into a cost file (when using a computer). These databases are usually offered in conjunction with a particular program and allow the estimator to enter his own prices or modify the prices or cost factors such as crew type, daily output, material unit price, installation costs, profit, and overhead, and the description of the items.

An alternative to using a dedicated database estimating program is to use one of the general purpose database management programs available for the IBM-PC,

such as *dBASE II* or *KnowledgeMan*. The contracting firm can design its own price file structures, data entry screen layouts, and reports. However, this may take more commitment and development time than the contractor is willing to spend. Also, these programs do not offer all the features that an off-the-shelf program does.

Basic Elements

In summary, here are the basic elements to look for in an estimating program. The first is to determine if the system contains a cost file. This is particularly important for anyone doing more than short or occasional estimates. Also, can the user easily update the cost file?

Second, does the system compute quantities from take-off dimensions, or does it simply calculate quantity times price? It is surprising how many systems do not let you enter dimensions.

A third requirement is that the program allow the user to subtotal elements within user-defined categories. For example, on a multibuilding project, subtotals should be available for each individual building and for all the buildings taken together. The programs should also allow the user to list out take-off details by the same categories. Some programs allow the user to put in a manufacturer's name with the material cost, which then lets you prepare a Request for Quotation or Bill of Materials for various material groups. Similarly, the user may want to obtain reports on similar labor items.

Finally, a program should produce summaries in a format that is easy to understand and allows the user to enter markups such as taxes, insurances, overhead and profit in as much detail as necessary. Organizational factors must also be considered. For example, is the computer to be used by one person or many, for one estimate at a time or several, and how fast does the computer operate?

Future columns will discuss other approaches to computerized estimating and some of the estimating software now available for the PC. ■

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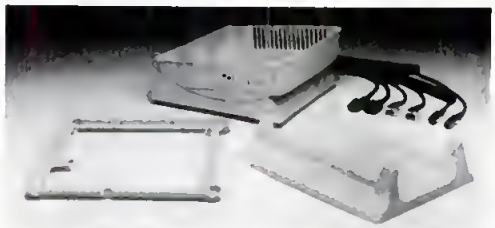

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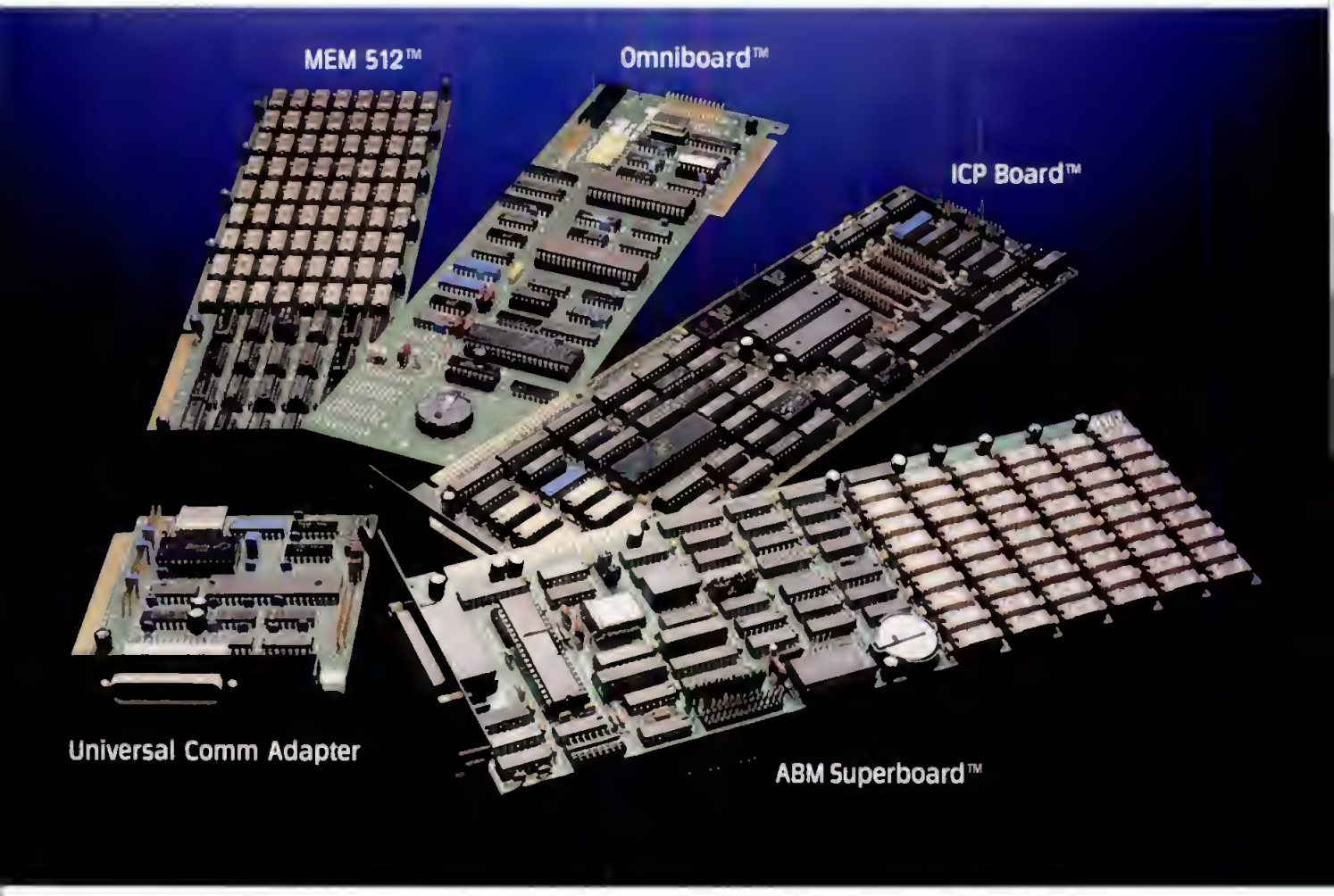

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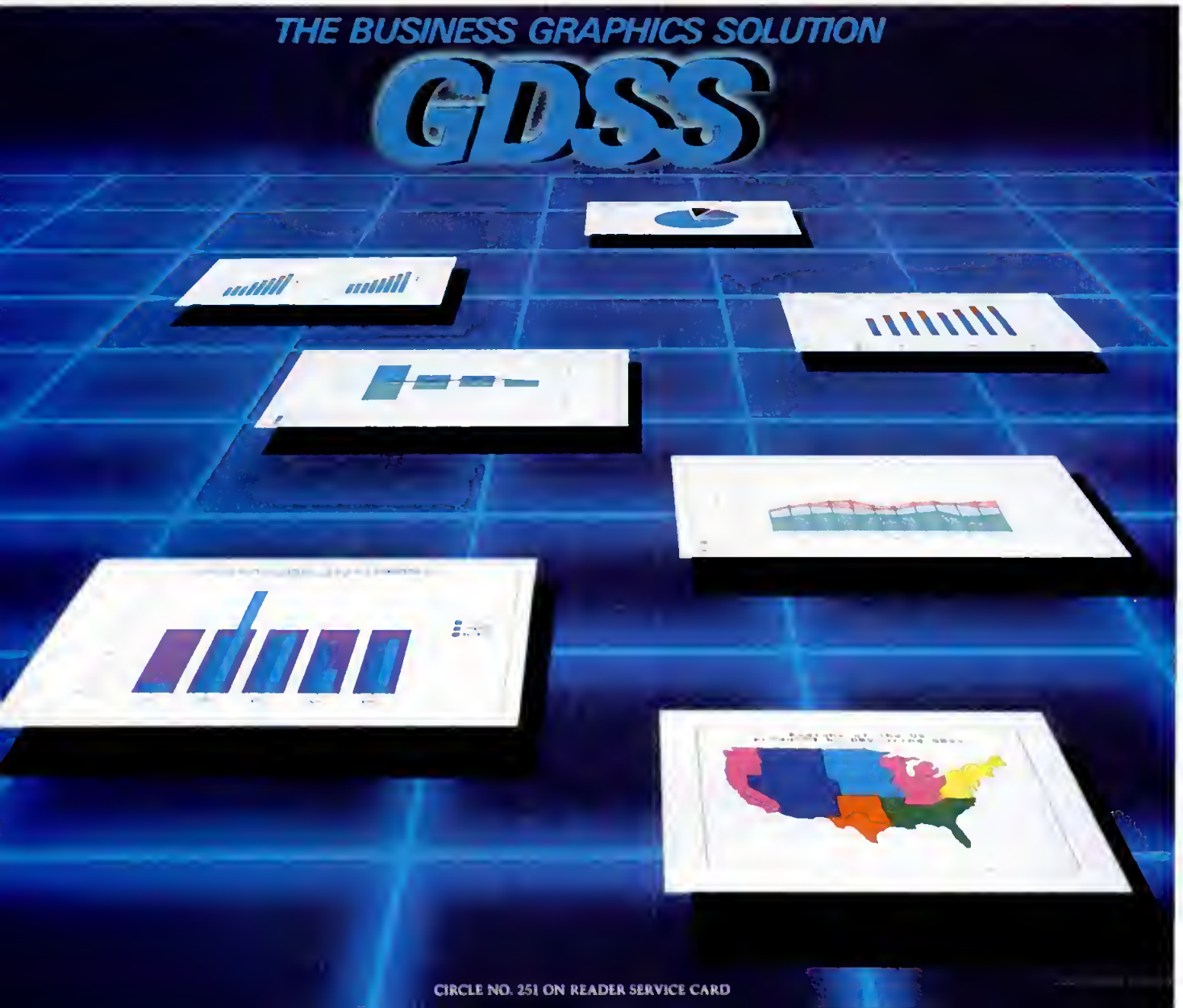


CIRCLE NO. 251 ON READER SERVICE CARD

MUMPS Fever

MUMPS, a powerful programming language originally developed for medical applications on mainframes, is now spreading to microcomputers. And everyone's trying to catch it.

Is it a programming language or a contagious disease? Whichever, it's spreading to the IBM PC.

We're talking about MUMPS (Massachusetts General Hospital Utility Multi-Programming System), an easy-to-use and powerful programming tool which is ideal for medical management and other data chores that require the manipulation of large amounts of textual data.

MUMPS was first contracted following a Harvard University effort to design an efficient time-sharing system for clinical data management in the mid 1960's. It was originally developed to run on the Digital Equipment Corporation (DEC) PDP-9, but programmers are constantly creating new strains, including several designed for the IBM PC. "The conversion for the IBM PC was a natural progression," says Jim Cruce of Innovative Computer Systems, Inc. in Denver. Innovative's version of MUMPS is available for the entire IBM compatible family (the Eagle 1600, Corona, Columbia, and Compaq machines).

In addition to the Innovative product, a PC-DOS version, called Micro-MUMPS is also available from the University of Califomia (see "MUMPS: A Cure For Swollen Programs" in this issue). Both issues support full ANSI MUMPS specifications, as well as implementation-specific special functions.

Another PC MUMPS system comes from Micronetics Design Corporation in Rockville, Maryland. This package, which recently completed field testing, follows the company's conversions of MUMPS for the Apple II and Motorola 6809 personal computers.

A Japanese version has also been announced. What is notable about this is that the normally reserved Japanese stated that MUMPS was going to be the preferred micro database language of the future. Powerful stuff, considering that our allies from the small island made a serious blunder. Their implementation of MUMPS does not support the indirection operator, a method of indirectly (or unspecifically) referencing a file or file node, which is one of MUMPS' most powerful features.

Disease's Childhood

MUMPS' earliest use was as a decision support system for physicians and health care professionals. Their requirements—including database management, word processing, multiuser communications, report generation, and accounting were built into the system then. And it's still going strong.

The Veterans Administration, for example, suffocating for years beneath a patchwork quilt of software, is a year and a half into a computer standardization project in 172 of its hospitals. The system is being written in MUMPS. Indications are that the transition is both ahead of schedule and performing above initial specifications—a rare occurrence in the wilds of government bureaucracy. Though the implementation is not limited to microcomputers, such acceptance is a firm step towards establishing MUMPS as the preferred medical systems environment.

Because of widespread use within the federal government—particularly the Veterans Administration—an epidemic of public-domain software programs have been developed for MUMPS users.

For instance, the United States Department of Health and Human Services supports the distribution and maintenance of COSTAR (Computer Stored Ambulatory Record), a MUMPS-run system also developed at Massachusetts General.

The MUMPS User's Group (MUG) in College Park, Maryland, offers a database management system called *File Manager*. It was originally developed by the Veterans Administration and is currently used for a range of hospital and private practice tasks including patient identification, pharmacy, laboratory, pathology, mental health, dietetics, radiology, nuclear medicine, and administrative systems.

AMA News from the American Medical Association recently listed two additional examples.

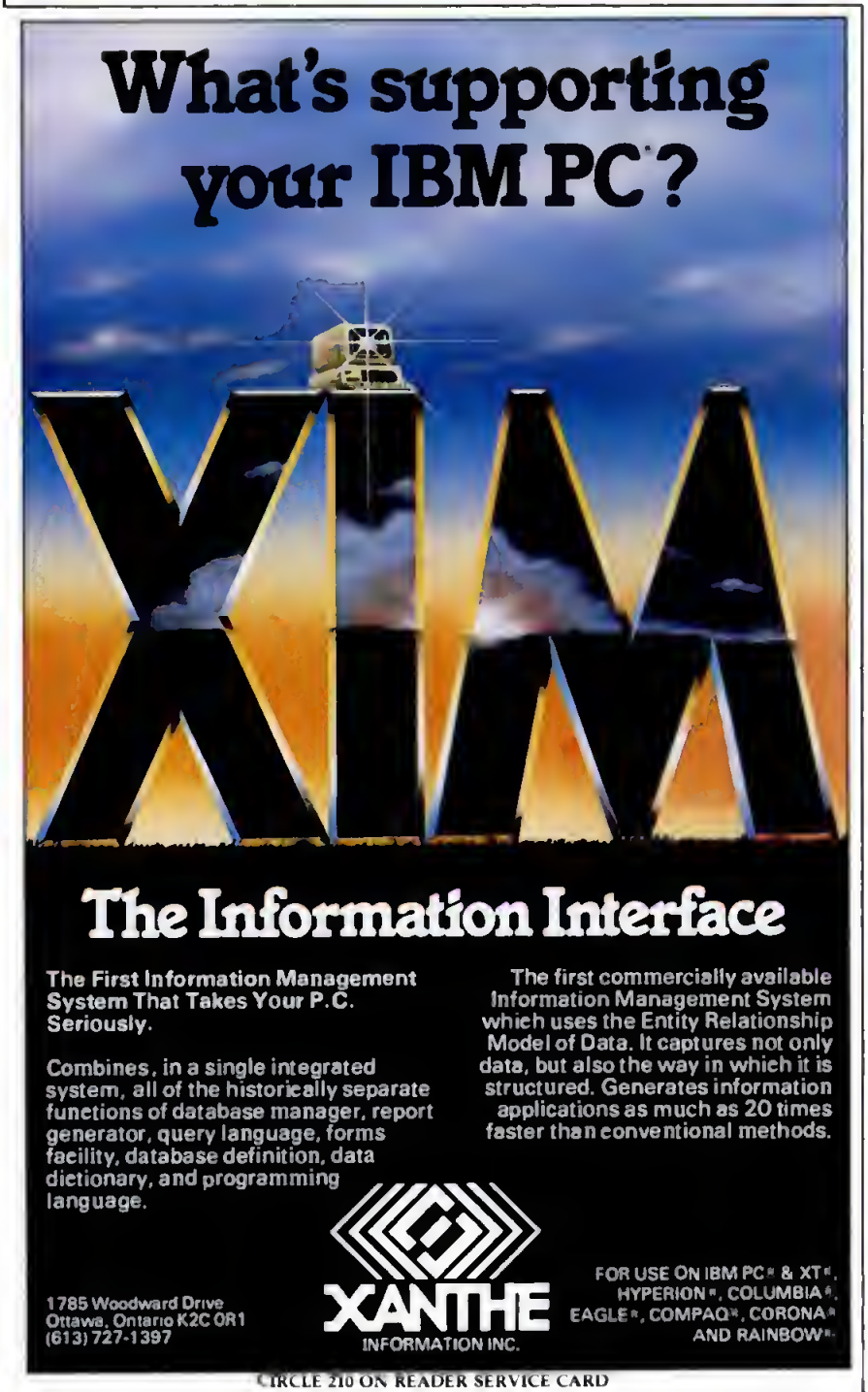
- The federal Center for Disease Control in Atlanta developed a computerized venereal disease registry for state and county health departments when national gonorrhea cases hit the one million mark several years ago. Epidemiologist Patrick A. Gould and his associates at the center wrote the software in MUMPS.
- At the University of Iowa Hospital in Iowa City, the blood center reportedly has reduced potentially fatal sample labelling errors from eight per day to two per month with the establishment of a MUMPS system to collect lab test results, print out labels, and correlate donor and recipient information.

And MUMPS isn't limited to large-scale institutions. Cruce hopes that the PC version will have a big impact on private practices. Medical office applications such as patient accounting, recordkeeping, insurance forms, and even research could all be aided by MUMPS.

But one respected MUMPS old-liner bids PC newcomers a word of caution: "MUMPS for the IBM Personal Computer is still a thing of the future," says original MUMPS designer G. Octo Barnett of the Department of Medicine at Harvard Medical School. "Comparing the available systems is risky at this time. It is clearly going to get better."

Proponents like to boast that MUMPS is a bonafide part of the standardized language clique, an adopted child of the American National Standards Institute (ANSI X11.1—1977), assuring that all implementations use the same commands, functions, and operations, which allows programs to be transported from machine to machine. Like BASIC—and unlike FORTRAN—it is an interpretive language, with built-in file manipulation, an interpreter, and its own operating system.

Several years ago, at an annual com-



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puter conference, Veterans' Administration programmer Robert Lushene found fault with MUMPS only in its number-crunching abilities. Otherwise, he was convinced that "MUMPS was the most flexible language" he had encountered.

At a previous National Computer Conference, Thomas Munnecke of the VA Hospital in Loma Linda, California, waxed that MUMPS is a language known for its "elegant simplicity" and compared it favorably to COBOL. "All of the utilities, control blocks, and organizational paraphernalia which are considered 'features' of COBOL-based systems are simply not needed with MUMPS," stated Munnecke.

A similar testimony comes from Dr. Richard Walters of the University of California, at Davis, who often poses the rhetorical question: "Is MUMPS the Cure?" and who recently capped his string of MUMPS public-domain micro software conversions with one for the IBM PC. Walters believes that MUMPS' true powers are inherent in its networking applications: "In small office environments with XT capability, MUMPS can run a complete office effectively. It can run as a standalone, or it can run networks."

A Challenge to the Minis

Walters and others consider MUMPS a micro-sized challenge to minicomputers in a fashion similar to the way early mini versions threatened the mainframes. "On a microcomputer, MUMPS can outperform COBOL on a minicomputer," says Walters. "The net result is better performance on smaller, cheaper machines."

Many users believe that the October 1983 announcement that the Veterans Administration has allocated more than $62 million for data-processing systems using MUMPS will be a breakthrough. A sizable portion of this allocation is going for PC, insiders claim.

According to MUMPS Users Group executive director Helmuth Orthner, "The Veterans Administration's acquisition is clearly a watershed for MUMPS. It gives MUMPS long overdue recognition of its ability to handle systems environments of unprecedented size with a speed and economy unmatched by traditional languages. We expect this commitment to gain the language wider acceptance and a more prominent role in the data-processing community." ■

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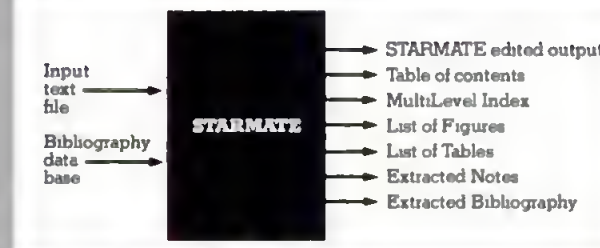

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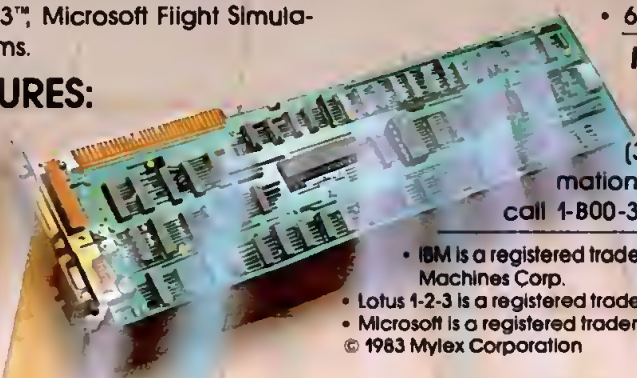

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CIRCLE 337 ON READER SERVICE CARD

Two Boards In One

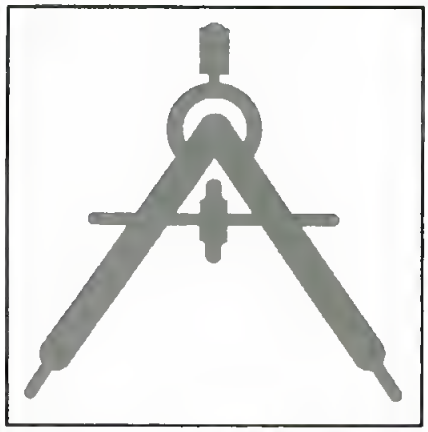
Amdek Corporation's all-in-one graphics board, teamed with versatile Halo software, presents a singular alternative to IBM's double-whammy color/graphics adapter.

Choosing an advanced feature video display card for your already bulging PC, or locating the right display card for your new PC is not always easy. Do you need a monochrome screen for sharp word processing vision but crave the vivid colors of video games? Will it be more fun to create your own graphics or to insert a disk and watch the program that someone else designed?

If you are agonizing over any one of these options, The Amdek Multiple Adaptor Interface (MAI) Board, combined with the *Halo Graphics Library* software, offers a practical solution. MAI and *Halo* are a powerful duo with remarkable versatility.

All In One

The single MAI video display card contains almost everything that is on the IBM monochrome card with parallel port and the IBM color graphics card combined. MAI has additional features that increase its performance: more graphics mode resolutions and palette selections, more on-board video memory (some switchable to system memory), high resolution light pen output, and a powerful set of *Halo* graphics primitives.



There's also a hands-on tutorial program called *LearnHalo* to acquaint novices and pros with *Halo*'s potential. All this in only one PC expansion slot!

In practical terms, this means monochrome capabilities for sharp character display and business use now. Later, it's an easy upgrade to standard IBM PC graphics and beyond by adding a color monitor. There are abundant advantages for the serious programmer, too. *Halo*'s powerful toolbox encourages rapid development of graphics applications programs.

Both IBM display cards use the Motorola 6845 video controller. The IBM cards were born in an era of 16K RAM chips and relatively low graphics modes resolutions. Total video memory on the IBM color card is 16K, which means that the 6845 controller is not used to its fullest potential.

The MAI designers also chose the 6845, in order to maintain compatibility with IBM graphics modes and to keep the board moderately priced. Other more versatile graphic controller chips are available, but these are higher priced and cannot easily be made IBM compatible. The MAI sports the full 64K RAM chips now available, to yield a whopping 128K of video memory. The extra memory allows enhanced graphics resolutions and palette choices and more memory pages. The higher density memory chips also make it possible to fit more functions on a single IBM-sized expansion card.

When enhanced resolution modes are not in use, the 64K of parity-checked video memory not used for display may be switched into system memory.

The MAI monochrome mode offers eight 80-by-25 character memory pages in contrast to the four on the IBM monitor. The monochrome mode and the parallel printer port are similar to IBM's, and

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sort staff by surname with salary greater than 5000 dollars show surname break-on age & total salary showing the heading "SAMPLE REPORT--DATED: $ Page: #"

From idea to report in two minutes, fifteen seconds.

The report produced by DAX PLUS was formatted automatically and includes the heading shown above, the current date and the page number at the top of each page. Using DAX PLUS, this report could be produced by a beginner in less than three minutes. Producing a similar report using most other popular data base managers would be a major undertaking.

Listed below are some features of DAX PLUS which are not found in dBASE II,* another data base manager for microcomputers:

FEATURE	DAX PLUS	dBASE II
English language inquiry processor	YES	NO
User may easily design the layout of data input forms	YES	NO
A time data type allows calculations to be performed on hours and minutes—this is invaluable to time cost applications.	YES	NO
Automatic report generator eliminates the need to manually format each report	YES	NO
Full data entry validations includes case conversion, range checking, and pattern matching	YES	NO
Extensive on-line help is available	YES	NO
Menu or English language command driven	YES	NO
User may define new command vocabulary	YES	NO
Simple mail-merge facilities	YES	NO
Simple file structure allows easy access to data	YES	NO
Calculations may be included in an English inquiry	YES	NO

RBP

To further simplify things for the end user, DAX PLUS has a special feature called RBP which allows a series of inquiries to be processed together. This means complicated applications can be easily operated by an inexperienced user with a few simple commands.

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MAI's light pen resolution exceeds IBM's.

It's in the color graphics modes that the system really shines. There is one problem, though; in the graphics modes, which use 400 horizontal lines, the display is interlaced. This means that the CRT refresh rate, which is normally 60 hz, will be slowed to 30 hz when using these modes. This will result in screen flicker on most monitors, but can be avoided by using a monitor with long persistence phosphors.

A Programmer's Toolkit

The *Halo* software is a set of graphic subroutines or "primitives" written by Media Cybernetics. Programmers may call the subroutines from within an application program for functions such as line drawing, circle drawing, text, and hatch fills. The subroutines are written in 8086 assembly language, support all MAI graphics modes, and provide more functions than IBM BASIC graphics commands.

The *Halo* library included with each MAI card is designed for use with the IBM BASIC interpreter. *Halo* versions for C, FORTRAN, and COBOL compilers are available as options.

Halo combines desirable features from several graphics "standards" that are being proposed by special interest groups (none has been universally accepted yet). It includes, of course, the usual graphics primitives such as line, circle, arc, and box. It can also scale, rotate, and stretch text in many directions and create hatch patterns and pie charts. Animators will appreciate the display page flipping and area move functions. Some other intriguing features to explore are adjustable cross-haired graphics cursors, separate text cursors, clipping, screen dump functions, and light-pen support. *Halo*'s documentation is adequate and generally easy to follow.

Different versions of *Halo* are available for other advanced-feature display cards, and programs designed to use *Halo* routines need only minor revisions to make them portable to other cards that *Halo* supports.

The two-board IBM offering does have some advantages over MAI. MAI does not have a composite video connection or an RF modulator interface, but lack of these elements won't pose a major problem for most users. There is another limitation, however, that is more problematic. Though MAI provides both monochrome and color graphics capabilities, both may not be used simultaneously. The single 9-pin video connector on the back of the card, can be connected to only one monitor at a time.

> Amdek has hit a realistic price-performance combination.

While simultaneous use of both monitors is not a significant consideration for many popular programs, sophisticated CAD and graphic design programs often use a monochrome monitor for alphanumeric information and a separate color monitor for graphic images. Programmers will be happier with separate monitors, too, during graphics program development, long sessions spent viewing text on some color monitors may cause eyestrain.

For these and other applications requiring simultaneous use of both monitors, a second video card will be needed. MAI allows another video display card to be present as long as it does not encroach on the MAI address space. For example, two MAI cards could be used, one for monochrome and the other for color.

Changing Modes

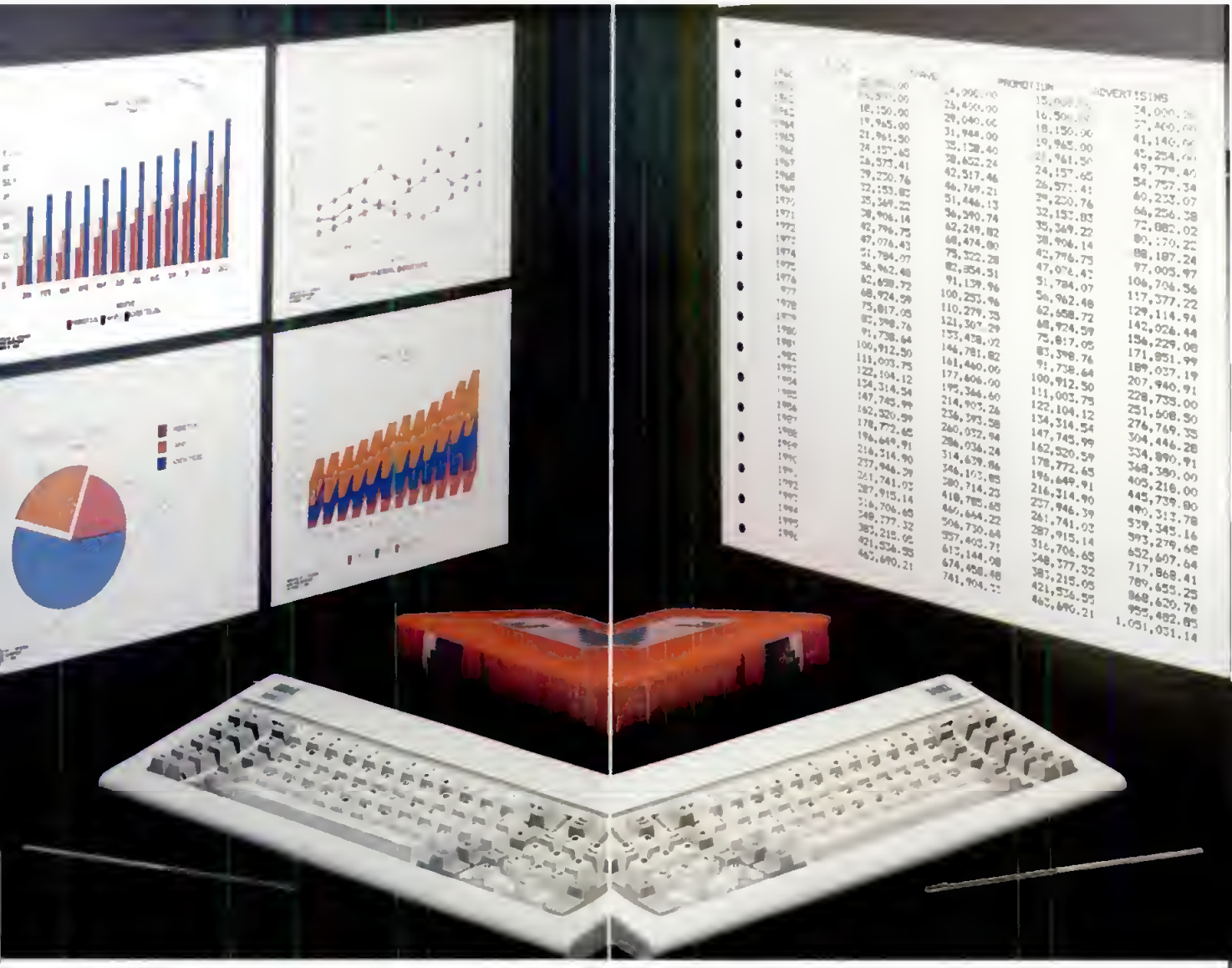
The default configuration for monochrome or color graphics on the single MAI is set by internal DIP switches. Theoretically, modes could then be changed by setting the 6845 registers through software. According to Amdek, IBM BIOS prevents this because both display cards reside in one slot. Unfortunately, there appears to be no alternative to opening the computer when changing between display modes using a single MAI card.

Another problem is that the appropriate monitor must be reconnected every time a display mode switch is made because there is only one monitor connection. This must be done carefully because video signals could be transferred inadvertently from the color graphics card to an IBM monochrome monitor, which could damage the monitor.

Programs designed for the standard IBM card will run as usual, but they will not automatically take advantage of the enhanced MAI graphics modes; the software vendor must create a version that will fully support MAI. Although limited converted software exists now, *Halo*'s portability and aggressive marketing by Amdek are likely to influence software developers. Many are already planning versions of their packages that will fully support MAI.

MAI could be even better if it had 16 colors in high resolution, analog RGB output, color mapping, graphics on the monochrome monitor, an external display mode switch. . . . The list could be longer if price weren't a consideration. However, Amdek has hit a happy and realistic medium: an excellent price-performance combination within the reach of a sizable audience. MAI is a highly appealing vehicle for CAD and other graphics applications. The attractive price, one-year warranty, and excellent technical support make it a welcome and strong contender in the marketplace. *Halo*'s powerful subroutines should provide a workable "standard" for the next round of advanced graphics applications for the IBM PC. ■

Allen E. Meilach is a Los Angeles computer graphic consultant specializing in architectural CAD, systems integration, and 3-D graphic illustration. He coauthored a computer dictionary and won several prizes for computer artwork.



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CIRCLE 265 ON READER SERVICE CARD

Educating The Individual

Traditional teaching methods have emphasized group instruction. Now computerized interactive instruction offers a method of responding to each student's needs.

Phillip of Macedonia hired the best instructor in the business to tutor his son. The lad grew up to be one of the most assertive and successful entrepreneurs and CEOs in world history. No small part of the tremendous achievements of Phillip's son, Alexander the Great, may be attributed to the individualized, interactive instruction he received from his private tutor, Aristotle.

Centuries later, one must still pay a princely sum for a good private tutor. Fortunately, computers can now provide affordable, effective, one-on-one, interactive instruction for an entire universe of subjects. Indeed, those not in education might view interactive instruction as a subset of interactive communications. Marketing professionals, for example, will find these instruction techniques applicable to point-of-sale demonstrations.

What is interactive instruction? Dr. Donald Payne, professor of educational technology at New York University, defines it as "an intercommunication process between a teacher or teaching agent and a learner, in which both parties make changes in a relevant way as a result of the experience." Whether the teacher is human or mechanical, the lesson responds to the learner's particular aptitudes and learning style. The individual must be

capable of a high level of input to make it work.

Product or Process?

Within the broad category of computer-aided instruction (CAI), a distinction has been made between teaching *with* computers and teaching *through* computers. Canadian educators focus on the product rather than the process; they call this teaching process computer-assisted learning, or CAL. They are teaching with, not through, computers.

Teaching through computers seems to have gained in popularity during the last 2 or 3 years. This technique is commonly called computer-based instruction; in this case the computer is the central figure in instruction, rather than an aid to a teacher, such as a preparatory or remedial support or wraparound review aid for a textbook. The human role in computer-based education is generally that of an adviser or instructional facilitator, rather than a teacher or trainer.

In the past, many obstacles have prevented the widespread use of CAI. As a mainframe application, its use depended upon costly and unreliable telecommunication links. Response time was slow, and when the processing load became heavy, educational jobs were often preempted in favor of business operations. Graphics were, with few exceptions, rudimentary. However, the most troublesome aspect of CAI has not been in its use but in its creation. Until the recent advent of competitive authoring systems, the authoring of a module of CAI required highly specialized programming expertise and many hours of effort. Consequently, good CAI programs seldom appeared outside of companies with big computers already installed and being amortized by business operations and logistics, and strong interests in training, research, engineering, and/or development. For example, CAI was widely used during the sixties and seventies by the Department of Defense. It had all the prerequisites: big computers, telecommunications networks, funds for programmers,

and, most importantly, a compelling need.

Military trainers are faced with conditions and objectives that are particularly well suited for CAI. There are relatively few experts available to train the multitudes of people who need to acquire technical skills, and they must be prepared to quickly train thousands more in an emergency. Military trainers also require a uniform, testable standard of performance with a procedure for documenting the results. Along with CAI, the computer can be concurrently used for computer-managed instruction, a mode that provides an automated analysis of the student population through pretests, progress monitoring, posttests, regression analyses, and documentation of results.

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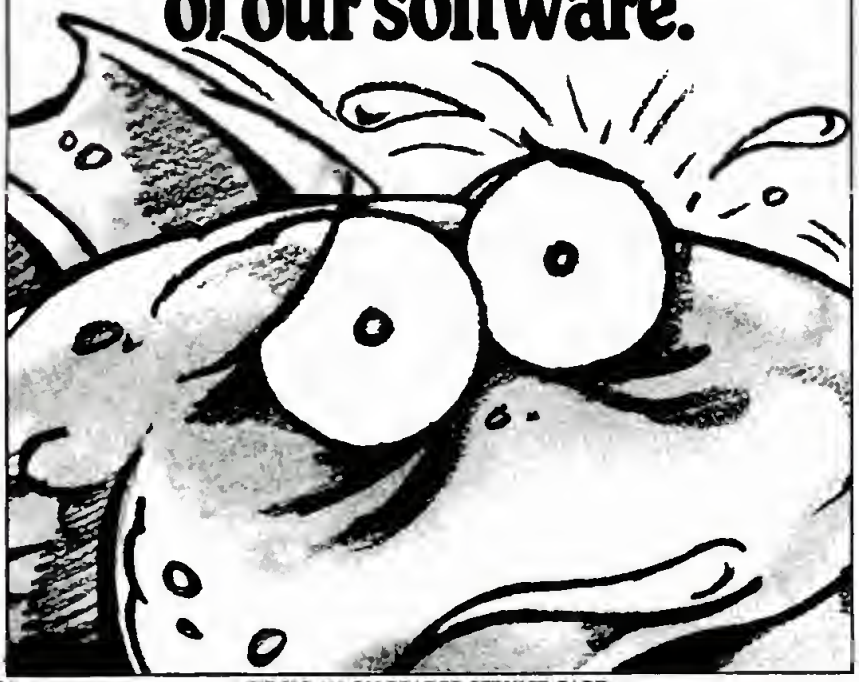

Setting the Pace

Interactive instruction distills its beneficial effects through individualized use. Each prospective learner has different attributes and traits. Interest in the subject, alertness, mood, language ability, intelligence, ego, preoccupations, and distractions contribute toward determining that individual's aptitude for interacting with an instructional source.

Interactive instruction software is referred to as courseware. When skills training is the desired outcome, the courseware is oriented toward specific objectives. By narrowing the options, courseware can limit irrelevant digressions by the trainee. Alternatively, courseware may be designed to support a learner's developing interests. This results in a process known as discovery learning, in which an individual traces a unique path through a matrix of educational possibilities. Tutorials, drills, simulations, and games are all legitimate means of structuring the interactive process. The selection of the means and content of the courseware depends upon the tasks, conditions, and objectives.

Highly interactive courseware has analytic and branching properties that respond to the learner's strengths, weaknesses, and interests and that can guide the student on a progressively more advanced course or, if necessary, to a remedial branch. Good courseware solicits feedback frequently to maintain alertness, and offers a variety of options to sustain the learner's interest.

Courseware is typically created by authoring teams of subject-matter experts, graphic artists, technicians, documentation writers, analysts, designers, and pro-

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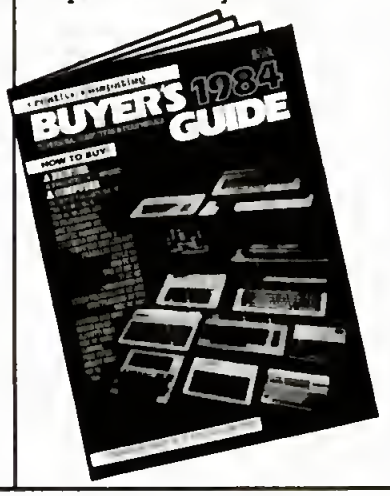

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grammers. However, the advent of "authoring systems," computer software packages containing instructional utilities, graphics generators, and computer-managed instruction macro commands, can do for the training profession what *VisiCalc* did for accounting. By eliminating the need for specialized programming skills in courseware development, authoring systems will not only drastically reduce the costs and time necessary to produce useful courseware, but also make it possible for smaller authoring teams to do the job.

The Video Interface

Interactive video is the hybrid offspring of television and data processing. Although the relative simplicity, power, and plummeting prices of microcomputers offer sufficient incentives to create interactive instruction without video, video can provide dynamic graphics that could not feasibly be stored in or called up from the computer's memory. Interactive video's motion pictures and abundance of still frames command student attention and provide more explanatory instruction, which helps the learner to retain the visual information longer.

Interactive laser videodisks offer nearly instantaneous video access by the learner, few problems with wear and tear, a combination of up to 30 minutes of motion pictures or 54,000 still frames per side, slow motion and unlimited stop action at any frame, plus inexpensive and fast reproduction of disks once the original master has been produced. These are the ones to watch; the technology is relatively new but progressing quickly.

Interactive instruction, with or without video, is becoming a popular teaching method, especially when a student population is widely dispersed both in aptitude and geography, when there is a shortage of subject matter experts, and when many theories or facts need to be learned in a short time. Customized or off-the-shelf, interactive courseware is a tireless, patient, erudite, nonjudgmental, highly individualized teacher. ■

Bob Rosensweet is director of the Interactive Authors Guild, an associate producer of instructional media for Learningware Corporation, an adjunct professor at New York University's Data Processing and Systems Analysis Institute, and a command information officer for the Army National Guard.

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Edited by Sol Libes

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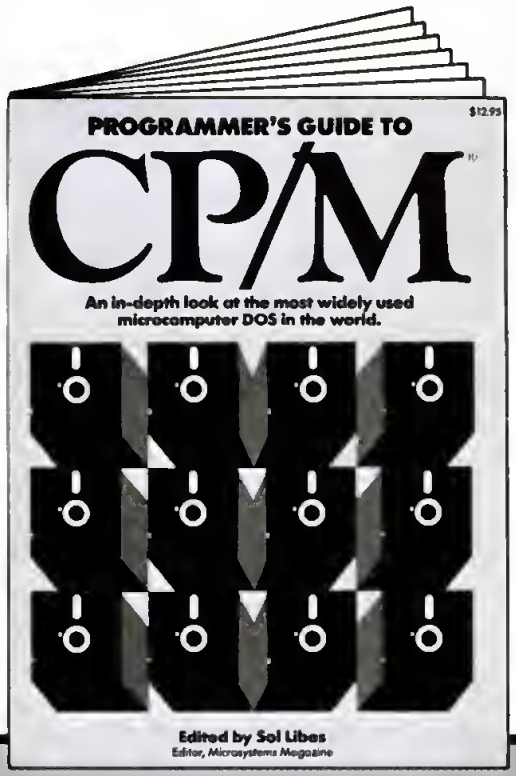

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New On The Market

Hardware

Sweet-P Six Shooter

A multiple-pen plotter, capable of switching to any of six color pens under software control. The plotter offers features including a plotting speed of 14 inches per second, both serial and parallel interfaces, 19 English and foreign language sets, and 2K bytes of buffer memory storage.

The Sweet-P Six Shooter, model 600, operates under the *Sweet-P Graphics Language (SPGL),* and can be used in both single and multiple user settings. In addition, the plotter is also compatible with the *Hewlett-Packard Graphics Language (HPGL),* permitting the unit to be used with graphics software incorporating the *HPGL* commands.

The plotter automates multiple pen usage by housing six pens in a rotating carousel, which changes and caps pens during operations per software instructions. Pens are available in 12 colors; by using pre-loaded carousels, the operator can quickly change color palettes, or change from paper to acetate transparency pens. The unit will also accept Rapidograph-type pens for engineering and CAD applications.

Paper sizes accommodated by the unit include 8½ x 11 inches and 11 x 17 inches.

(List Price: $1,095)
Enter Computer, Inc.
6867 Nancy Ridge Dr.
San Diego, CA 92121
(619) 450-0601

CIRCLE 800 ON READER SERVICE CARD

ENVAX 600

An intelligent communications processor capable of sending and receiving data over a variety of networks without tying up the user's system. The unit can communicate with Telex, TWX, and DDD lines without requiring the user's system to be converted into a dedicated telex machine. It is equipped with a printer port, permitting incoming messages to be printed as they are received. Messages can also be saved to disk for later review.

The ENVAX 600 is available with either a 300 or 1200 baud internal modem, or both. Other features of the device include the ability to send/receive communications in unattended operation; automatic delayed transmission, a feature which takes advantage of times when transmission rates are lower; an unlimited phone directory; automatic redial and answerback verification; automatic message counting; built-in RAM of from 16K to a total of 48K; and battery backup capable of retaining data in RAM without AC power.

(List Price: $1,195-$2,130, depending upon configuration)

Requires: Async communications card, terminal emulator software.

ENVAX Systems, Inc.
3330 Stovall
Irving, TX 75061
(800) 527-7700
(214) 986-1151
Telex: 73 0022
TWX: 910-860-5761

CIRCLE 797 ON READER SERVICE CARD

Sweet-P Six Shooter, Enter Computer, Inc.

DXY-800 Plotter, Roland DG

DTC Style Writer

A daisy wheel printer featuring a 35K buffer memory, permitting up to 20 pages of data to be stored in printer memory, thus freeing the user's system for other tasks. As an option, a 67K expanded buffer is also available.

Other features of the DTC Style Writer include: bidirectional operation; automatic proportional spacing; standard parallel interface; graphic plotting; two-color printing; and a momentary pause for paper, ribbon, or print wheel changing. Print wheels are available in 17 different fonts. The DTC Style Writer also incorporates a self-test routine which is isolated from the user's system and can be called from the printer's front panel controls. Error conditions are indicated by L.E.D. indicators.

Available options also include a forms tractor for continuous paper feed, and a bi-directional cut sheet feeder.

(List Price: $899; 67K buffer option $49)
Data Terminals & Communications
590 Division St.
Campbell, CA 95008
(408) 378-1112
TWX: (910) 590-2436

CIRCLE 798 ON READER SERVICE CARD

DXY-800 Plotter

An eight-pen X-Y plotter with both serial and parallel interfaces, capable of producing up to 16 different typestyles. The plotter also includes 8K of on-board RAM and can operate at up to a 60-degree vertical angle. The unit can plot graphics up to 11 x 17 inches in size.

The DXY-800 Plotter has a variety of printing capabilities, including circles, grids, fills, relative moves, and special marks.

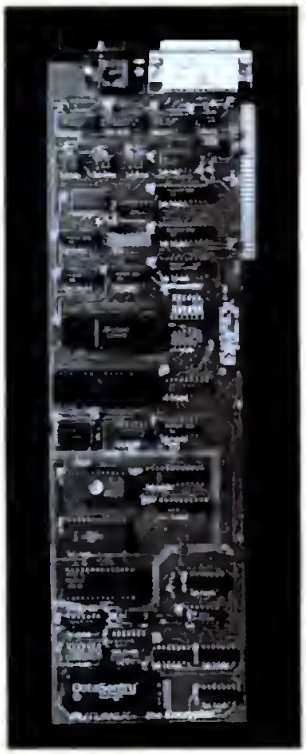
(List Price: $995)
Roland DG
7200 Dominion Cir.
Los Angeles, CA 90040
(213) 685-5141

CIRCLE 799 ON READER SERVICE CARD

SNA Encryptor 305

An SNA data encryption board designed to interface directly with a user's system and IBM mainframe systems with encryptographic support features. It permits a user's system to communicate with IBM 30XX and 40XX mainframes using encryption techniques for secured data transmissions. Only systems which are specifically configured to receive data transmitted through the SNA Encryptor 305 can process the data transmissions.

In addition, the board provides the user with synchronous and asynchronous communications capabilities. The async communications facility is compatible with the IBM async communications adapter; the sync communications portion of the Model 305 is tailored to respond to the SNA/SDLC network, and permits communications with the



SNA Encryptor, Futerex Security Systems

IBM-compatible host or other SNA/SDLC systems without additional terminal emulator software.

(List Price: $1,595)
Futurex Security Systems
9700 Fair Oaks Blvd.
Fair Oaks, CA 95628
(916) 966-6836

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HP Digital Wand System

A bar code reader which attaches to the DB-25 parallel printer port within a user's system. Three bar code formats are supported using decoder/printer software modules: CODEABAR (numeric only), CODE-39 (alphanumeric), and UPC-A (the Universal Product Code). The decoder software can link with MBASIC, the BASCOM BASIC Compiler, and *dBASE II*. Reasonable quality bar code may also be printed using Epson or Diablo printers and the printer software module.

(List Price: HEDS-3000 Wand/Interface $119.95; software modules $99)
Computer Data Systems
1532 Elbridge St.
Philadelphia, PA 19149
(215) 744-5582

CIRCLE 794 ON READER SERVICE CARD

PLP-8 Matrix Printers

A series of 80 and 132 column dot-matrix printers featuring a heavy-duty 9 needle print head with 300 million+ character life. The printers operate at up to 270 characters per second. Head travel is rated at 27 inches per second and tractor line feed requires only 35 milliseconds in either 6- or 8-lines per inch modes.

A parallel interface is standard, with a serial interface available as an option. The serial interface can accept 110-9600 baud, current loop, as well as Xon/Xoff and DTR protocols. Space is provided within the printer's circuitry for an 8K-64K buffer.

The printer front panel controls permit selection of 16 form lengths and 32 positions of vertical and horizontal tabs. The built-in character sets, in plug-in EPROM form, contain 96 characters plus 96 European and math characters.
(List Price: $675-$895, depending upon model)
Practical Automation
P.O. Box 313
Trap Falls Rd.
Shelton, CT 06484
(203) 929-5381

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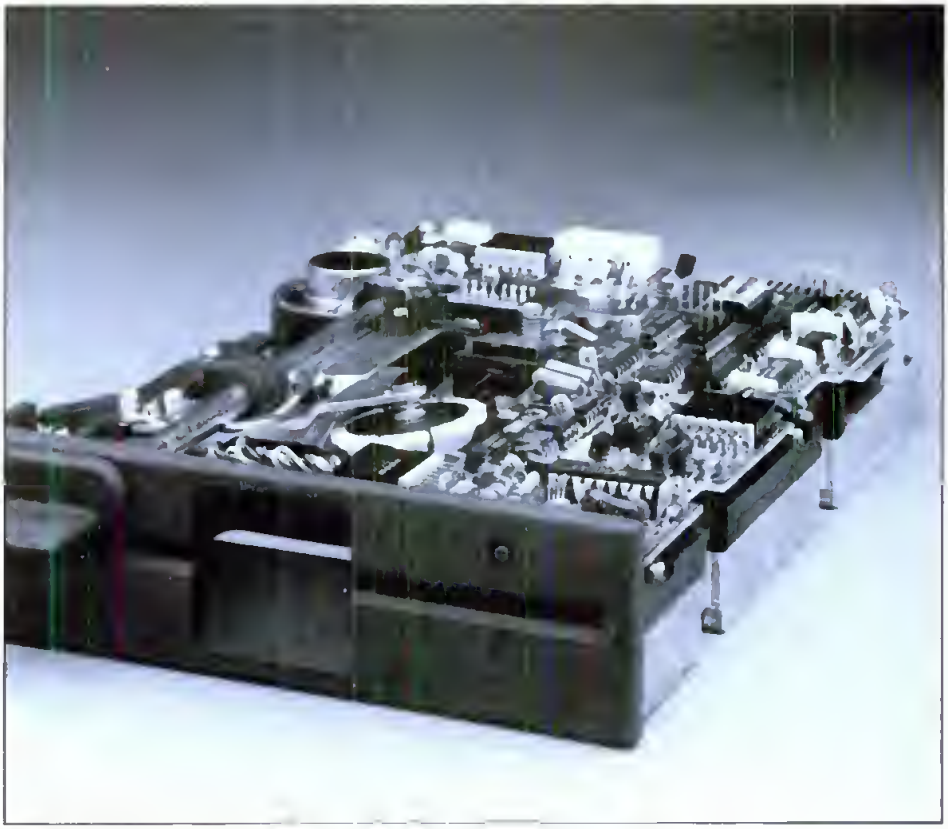
QumeTrak 142

A half-height floppy disk drive providing 500Kb of unformatted (327Kb formatted) storage capacity using double-sided, 48-tracks-per-inch recording techniques. The QumeTrak 142 incorporates contoured ceramic READ/WRITE/ERASE heads for longer media life, estimated at 15,000 hours (5 years typical usage).

Two versions of the QumeTrak 142 are available. The standard model offers an average access time, track-to-track, of 12 milliseconds. Optionally, the drive can be ordered with a 6-millisec access time.
(List Price: 12-msec version $270; 6-msec version $280)
Qume Corp.
2350 Qume Dr.
San Jose, CA 95131
(408) 942-4000

CIRCLE 790 ON READER SERVICE CARD



QumeTrak 142, Qume Corp.

Sprinter Printer

An 80-column dot-matrix printer with a parallel port and five built-in character sets. The unit operates at an average speed of 160 characters per second, features both friction and tractor feed mechanisms, user-programmable character design, a 4K buffer, and full graphics capabilities.

The Sprinter is equipped with a SoftSwitch keypad, providing the user with a convenient means of changing the printer's operating parameters. The keypad controls functions which include horizontal tabbing; selection of alternate character sets; form length; line feed on CR; baud rate; horizontal print density; vertical tab stops; and vertical line density. The device stores the user's parameter settings in battery-backed RAM, which retains the set functions even with the power off.

The built-in 4K buffer incorporates data compression techniques, dynamically allocated for downline character set loading from software. Available as options are 20K, 32K, and 68K buffers, the last of which can hold up to 34 pages of data within its memory.

Other options available for the Sprinter include IEEE 488 and RS-232 interfaces.

(List Price: $795)
Micro Peripherals, Inc.
4426 S. Century Dr.
Salt Lake City, UT 84107
(800) 821-8848

CIRCLE 796 ON READER SERVICE CARD

***Sprinter Printer**, Micro Peripherals, Inc.*

Multibus Expansion Chassis

An expansion chassis permitting users to connect Multibus cards to their systems. The cabinet accepts up to six cards in the Multibus configuration. Front panel controls include an on/off power switch and push-button reset. The cabinet also incorporates a four-voltage power supply, which can deliver +5,−5,+12, and −12 volts as required. The power supply also features short circuit protection, +5V overvoltage protection, input surge current protection, EMI filtering, and a 16-millisecond holdup time. The unit is cooled with two 4-inch quiet fans.

(List Price: $1,300)
Bit3 Computer Corp.
8120 Penn Ave. So.
Minneapolis, MN 55431
(612) 881-6955

CIRCLE 792 ON READER SERVICE CARD

Personalfeeder

A single-bin mechanical sheet feeder available to fit a range of letter-quality and near-letter-quality printers. The device feeds paper sizes from 6 x 7 inches to 14 x 14 inches, and collates paper in proper print sequence. The input bin can hold up to 200 sheets, has a one-step operator bin adjustment, and can accept additional paper loading during printing.

The Personalfeeder fits the following printers, with additional printers to be added in the near future: Diablo 620, 630, and 630 ECS; Qume Sprint 8, 10, and 11; Ricoh 1300 and 1600; NEC 2000, 2500, and 7700 series; TEC F10; Juki 6100; and the Daisywriter 2000.

(List Price: $495)
ZIYAD, Inc.
100 Ford Rd.
Denville, NJ 07834
(201) 627-7600
Telex: 13 6024

CIRCLE 789 ON READER SERVICE CARD

Net/One Personal Connection

An EtherNet-compatible Network Interface Unit (NUI) permitting linkups between IBM and Texas Instruments personal computers. In addition, the plug-in board also supports integration with mainframe systems via the IBM System Network Architecture (SNA) protocol.

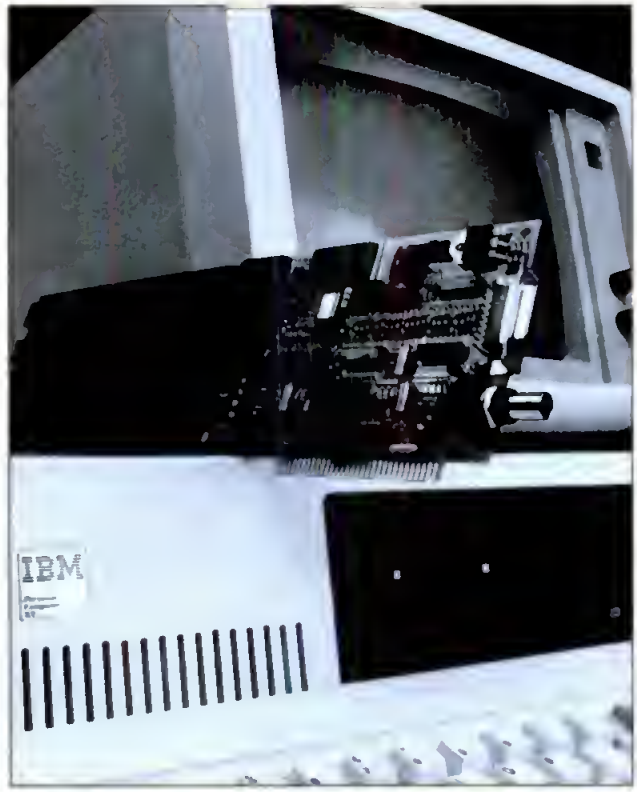
User's systems configured with the Net/One Personal Connection can run any application under PC DOS (MS-DOS) without modification. In addition, applications can be shared across the network. Networking of applications is handled by the addition of five new user commands to the PC DOS (MS-DOS) operating system, supplied as software packaged with the board.

The Net/One Personal Connection also features a shared disk server and print server which executes *Diskshare* and *Printshare* software from the board's manufacturer. The disk server manages the shared access to all files and application programs stored on one or more hard disks at the server station. *Diskshare* also provides multilevel password protection of files. *Printshare* permits users to access printers attached to the network. Application programs or keyboard-generated output can be automatically redirected to a networked printer via a spooler, thereby freeing the workstation to begin new tasks before the print function has terminated. The Net/One Personal Connection allows workstations to access multiple disk and print servers simultaneously.

(List Price: NUI board $850; Printshare and Diskshare software $500 per server)

Ungermann-Bass, Inc.
2560 Mission College Blvd.
Santa Clara, CA 95050
(408) 496-0111

CIRCLE 795 ON READER SERVICE CARD



***Net/One Personal Connection**, Ungermann-Bass, Inc.*

Software

The Exterminator

A BASIC programming aid that eliminates the need for program line numbers, allows IF-THEN-ELSE control statements to take up more than a single line, and permits programs to be composed of materials contained in different source files. The software allows the programmer to work in Structured BASIC to create new applications, then converts the application to run under IBM BASIC. *The Exterminator* provides four different output formats and can produce programs that will run under either the IBM BASIC Compiler or Interpreter. Additionally, *The Exterminator* allows parts of programs to be reused, permitting the building of software sub-program libraries.

Instead of line numbers, the software allows descriptive labels to be used as line references, which facilitates both the creation of sub-program libraries, and moving sub-program routines around within an application. Labels allow the sub-program's location within an application to be changed without the often tedious requirement of changing every reference to that sub-program by other components of the application.

IF-THEN-ELSE control statements, limited by IBM BASIC to only one line, can take up as many lines as needed to express a function under *The Exterminator*. This allows more natural expression of concepts by the programmer and makes later modifications simpler.

(List Price: $49)
Requires: 64K, one disk drive, PC-DOS.
Micromedia
Box 33071
Northglenn, CO 80233
(303) 452-5566

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Strobe M100 Plotter (RS 232) 499

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VersaWriter Tablet . . . 235
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SEATS

A theater management program with functions that include the ability to handle ticket sales and exchange, reservations, ticket inventory control, cash reconciliation, ticket printing, seating availability reports, and sales reports.

SEATS, an acronym for *System for Entry and Access to Theater Seating*, can support multiple theaters, multiple events running simultaneously, and multiple price schedules. All of the software's functions are menu-controlled for ease of use, and on-site installation, training, and hot-line support are also available.

(List Price: $2500)

Requires: 128K, two disk drives, PC DOS, dot-matrix printer.

Jacobson Systems, Inc.
333 E. 75th St.
New York, NY 10021
(212) 535-6506

CIRCLE 764 ON READER SERVICE CARD

Spellagraph

A spelling game for children, where each correctly spelled word takes the child closer to learning the mystery of a secret message. The game uses rebuses (word-picture puzzles) to teach the spelling of 400 words. Each rebus is hidden behind a grid. Players may uncover various portions of the grid only when they correctly spell words missing from context sentences.

Spellagraph*, *DesignWare, Inc.

Players score points for correct spellings and, as the word-picture puzzle is revealed, for deciphering the meaning of the secret message. If a word is misspelled, the correct spelling of the word appears and must be entered by the player before the game can continue. The 400 words are divided into multiple skill levels to provide increasing challenges. Players may also create their own spelling lists and sentences.

(List price: $39.95)

Requires: 64K, one disk drive, PC DOS.

DesignWare, Inc.
185 Berry St.
Bldg. 3, #158
San Francisco, CA 94107
(415) 546-1866

CIRCLE 781 ON READER SERVICE CARD

Structured Interactive Design System

A computer-assisted, schematic design program designed as an enhancement for the FutureNet *DASH-1* CAE software system. The *Structured Interactive Design System (STRIDES)* permits the user to segment complex engineering drawing into sub-parts and use these component drawings as elements in building up complete system designs.

With the *STRIDES* package on the *DASH-1* system, a change in one element drawing is automatically incorporated into the overall design, affecting all related components of the project under design. This includes automatic updating of pin lists, net lists, and lists of materials. *STRIDES* is designed to manage an entire document tree from the top block diagram down to individual components, including VLSI equivalents at the gate array or chip level.

STRIDES can support up to 99 subordinated levels of drawings within a project. Progressively finer detail emerges as the user moves through the layers of drawings in a document tree. Within each drawing level, documents can be called up for display or editing with a single keystroke and changes made at each level are stored in temporary memory until a final save command makes a permanent record of all editing changes.

(List Price: $1,900)

Requires: 256K, two 320K drives, PC DOS, monochrome graphics board, printer or plotter, *DASH-1* software.

FutureNet Corp.
21018 Osborne St.
Canoga Park, CA 91304
(213) 700-0691
TWX: 910-494-2681

CIRCLE 763 ON READER SERVICE CARD

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The Diablo 32CQ: quality you can see at the Diablo dealer nearest you. Call 800-556-1234 ext. 186. In California call 800-441-2345 ext. 186. Diablo Systems Inc., A Xerox Company, Fremont, California.

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CIRCLE 224 ON READER SERVICE CARD

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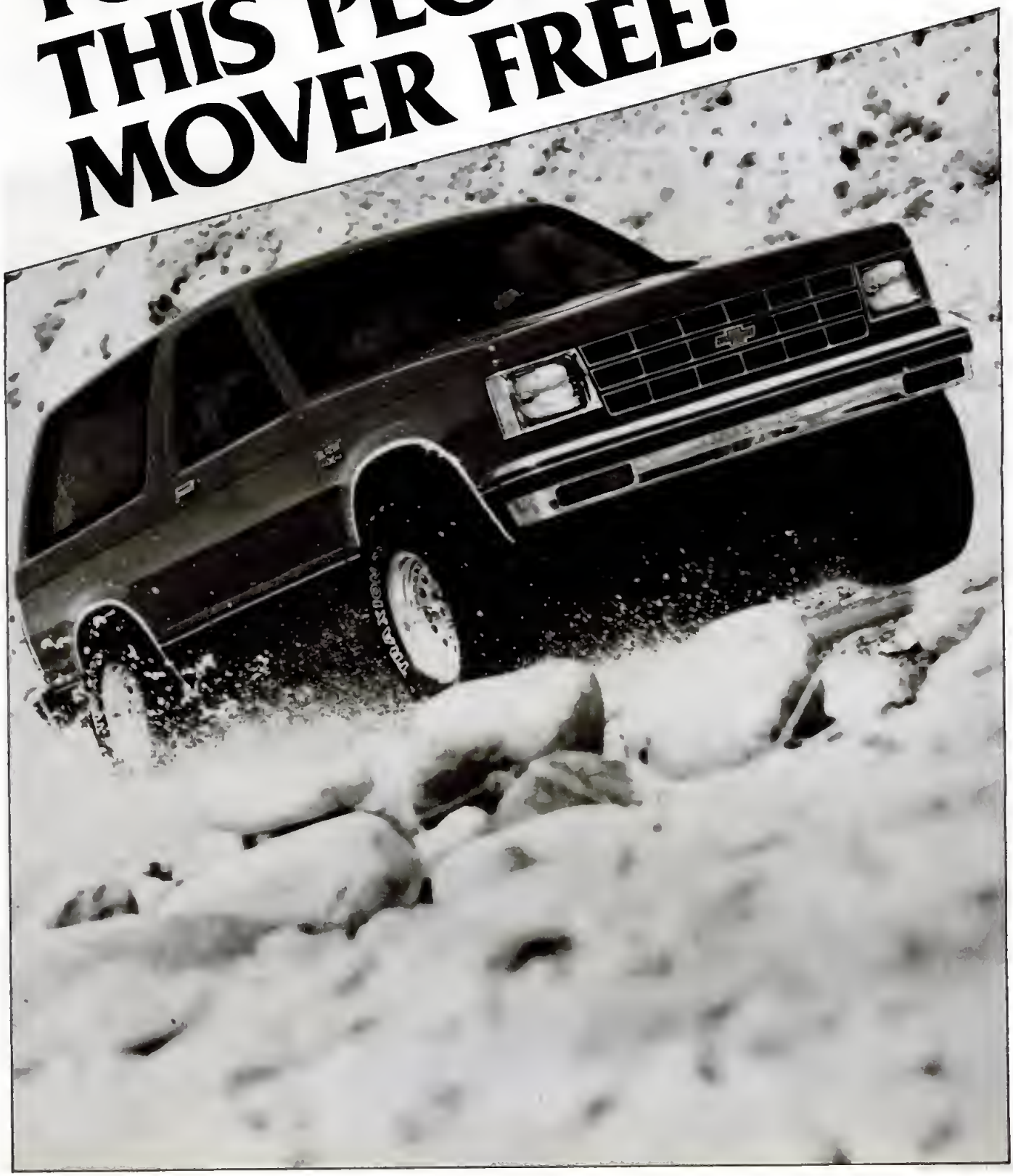

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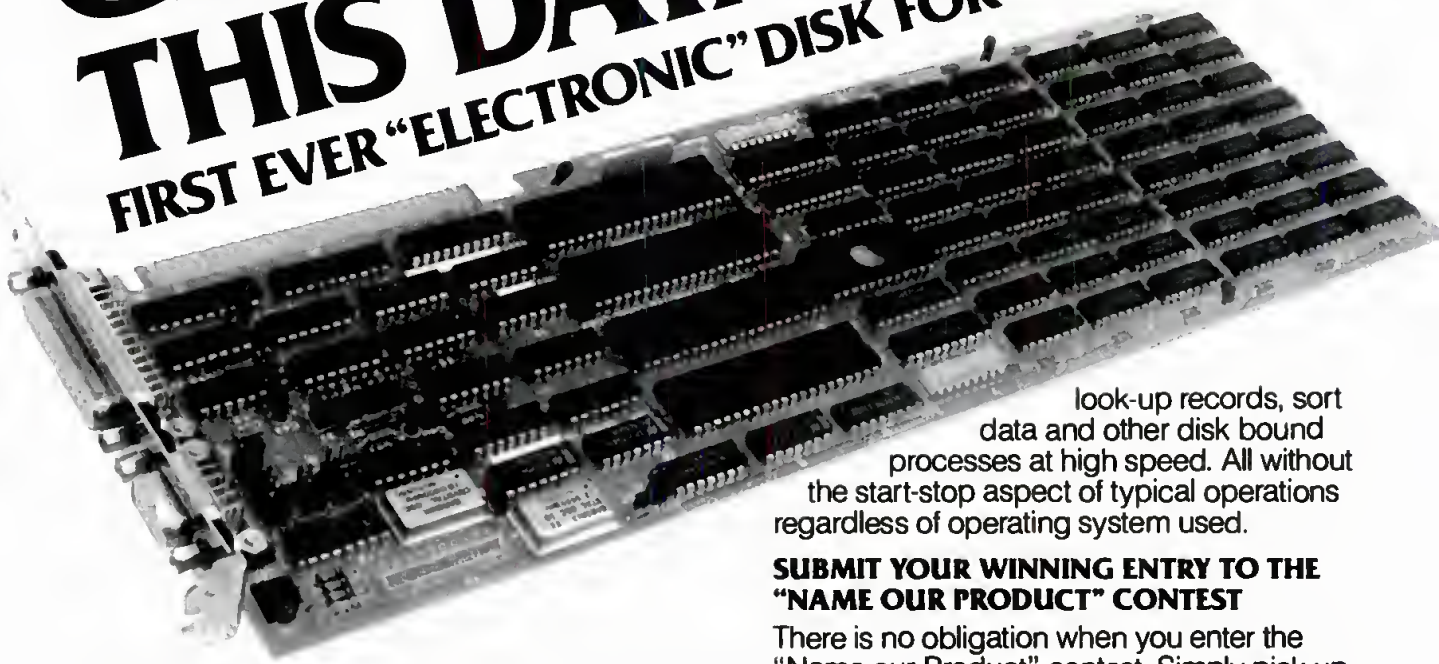

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WHAT IS AN "ELECTRONIC" DISK

"ELECTRONIC" DISK is the functional name we've given to this first-of-a-kind product for the IBM PC & XT. It's an operation-ready module offering to 368 KB for new or existing PCs. There's no software or sub-routines required. Just plug one in and you get instant data access ...up to 50x faster than a conventional floppy disk. And without inherent head and disk wear. Or electro-mechanical failures and data loss. The module also offers a U.P.S. (uninterruptible power supply) to make sure you won't lose data from power "glitches" or when power is temporarily removed.

WHY YOU'LL WANT ONE

The "ELECTRONIC" DISK gives your computer greater power for personal, multi-tasking or multi-user applications. You'll be able to continuously scroll documents, instantaneously look-up records, sort data and other disk bound processes at high speed. All without the start-stop aspect of typical operations regardless of operating system used.

CIRCLE 142 ON READER SERVICE CARD

SUBMIT YOUR WINNING ENTRY TO THE "NAME OUR PRODUCT" CONTEST

There is no obligation when you enter the "Name our Product" contest. Simply pick up an official entry blank from any participating IBM PC dealer. While you're there, your dealer can give you complete details on the "ELECTRONIC" DISK. Or, you can request an entry form and details directly from the factory by writing to the address below. Please include a stamped, self-addressed business size envelope.

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___ Please send me an official entry blank
___ Please tell me the name of the nearest participating IBM PC dealer

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Company (if appropriate)_____

Address_____

City_____State_____Zip_____

DILOG PC PRODUCTS

DILOG PC PRODUCTS
Distributed Logic Corporation
12800 Garden Grove Blvd.
Garden Grove, CA 92643
Phone: (714) 534-8950

Concentric Information Processor (C.I.P.)

A database management and report writing program featuring a screen display capability making the software easy to use. *C.I.P.* allows a user to see the results of report writing directly on the screen as it will appear on the printed page. In addition, by utilizing a horizontal scrolling capability, 132-column reports can be visually defined using an 80-column display. Titles and footnotes can also be created on-screen and formatted properly in conjunction with the report.

C.I.P. includes a step-by-step tutorial, and requires no complex programming syntax to operate. Instead, all command options are presented on the screen, and commands are performed using only a few keystrokes.

The software can interface with foreign programs such as spreadsheets, word processors, and other database management systems. The software's flexibility permits file reorganizations without the need to copy data to external temporary files or risk losing data. Unwanted fields can be eliminated with a single keystroke, leaving the remaining data unaffected.

(List Price: $395)

Requires: 128K, two 320K drives, PC DOS; PC XT: 192K, PC DOS 2.0.

Concentric Data Systems, Inc.
18 Lyman St.
Westboro, MA 01581
(617) 366-1122

CIRCLE 787 ON READER SERVICE CARD

PC/TaxCut

A tax preparation and planning program for users preparing federal income tax 1040 long forms. *PC/TaxCut* presents the user with a series of questions presented in a logical order. Upon completion of the questions, the software checks for whether the user is eligible for income averaging, alternative minimum tax, and performs the necessary calculations for preparing the federal tax return. Upon completion of the computations, the program can print out a finished 1040 long form, together with up to 30 IRS-approved schedules and supplementary forms.

PC/TaxCut can be integrated with the producers' *PC/Professional Finance Program (PC/PFP II)*, a financial management program that tracks income and expenses, identifies tax-deductible expenses, provides monthly budgeting capability with up to 1000 categories, writes checks, and performs a variety of other financial functions.

PC/TaxCut also features on-screen references to pages in the tax-assistance manual provided with the software. Each screen reference can direct the user in the best manner to respond to *PC/TaxCut*'s on-screen questions. As the user moves from question to question, the page reference number on the screen changes, guiding the user to whatever pages are appropriate.

(List Price: $255)

Requires: 128K, one 320K drive, PC DOS.

Best Programs
5134 Leesburg Pike
Alexandria, VA 22302
(800) 368-2405

CIRCLE 765 ON READER SERVICE CARD

Concentric Information Processor, *Concentric Data Systems, Inc.*

***Order Entry Module**, Micro Architect, Inc.*

Order Entry (OE) Module

A software module integrable with the manufacturer's *INV-X* inventory control system and/or *AR* (accounts receivable) system. The *Order Entry* module can simultaneously print invoices and update inventory files.

The software is designed to accept name and address information from the *AR* file, and print the invoice header information. Multiple inventory items can be entered singly, and each item is checked and updated interactively. After all items are entered, sales tax and shipping charges can be printed with a grand total, and the sales transaction is added to the *AR* file.

(List Price: OE module alone $98; with INV-X and AR systems $498)

Requires: 64K, one disk drive, PC DOS.

Micro Architect Inc.
6 Great Pines Ave.
Burlington, MA 01803
(617) 273-5658

CIRCLE 783 ON READER SERVICE CARD

The Coupon Manager

A menu-driven program allowing a user to maintain an inventory of manufacturers' and retailers' coupons and rebate offers. The software lists coupons and rebates by product, brand, store, and expiration date, with selection within each category.

The Coupon Manager purges expired offers, and monitors rebate requirements until they are met, when it prompts the user to mail the offer in.

(List Price: $49.95)

Requires: 64K, one disk drive, PC-DOS.

K-B inc.
P.O. Box 11526
St. Louis, MO 63105
(314) 968-3219

CIRCLE 736 ON READER SERVICE CARD

CBX86

A cross-reference utility designed for use under the CP/M-86 operating system. This CBASIC source file provides facilities which include cross-reference of variables and line numbers, CBASIC statements, CBASIC functions, and string and numeric literals. All cross-reference functions are user-selectable for each run.

The cross-reference option selections may be entered on the invoking command line or interactively. Options available include: type of cross-references to produce; print CBASIC source listing; include "%INCLUDE" files; and all or referenced-only line numbers.

Depending on available memory, CBX86 is designed to cross-reference up to 1200 items, with references for each item limited only by available disk space at run time. Each cross-reference listing is produced in sorted order, with each listing separate.

(List Price: $49.95)

Requires: 64K, two disk drives, CP/M-86, CBASIC.

System Consultants
P.O. Box 116126
Carrollton, TX 75011
(214) 492-1315

CIRCLE 735 ON READER SERVICE CARD

VIDEO TAPE TRACKER

A program for individuals wishing to organize their videotape libraries. *VIDEO TAPE TRACKER* can store and manage over 1,000 titles, and can print quick-reference listings by tape number, and/or movie title. It can search through lists by tape, title, or performer, and print numbered, titled labels for tapes.

(List Price: $39.95)

Requires: 64K, one disk drive, PC-DOS.

PROSOFT
Box 839
N. Hollywood, CA 91603
(213) 764-3131

CIRCLE 737 ON READER SERVICE CARD

Client Dental Billing PC

A program designed for CPAs, accountants, and billing services, for use in handling the accounts receivable needs of their dentist clients. The program allows accountants to establish a billing service relationship with their dental office clients, to process accounts receivable, and to print claim forms. The software includes all necessary forms for the client offices to use in recording their transactions. Data from these forms is used to generate bills, client payment receipts, monthly bills, monthly aged accounts receivable reports, periodic collections reports, and ADA universal insurance claim forms.

Other reports available from the *Client Dental Billing PC* program include daily summaries of billing done, payments received, Superbills prepared, receipts prepared, delinquency reports, and income activity for up to ten dentists in a practice. Optional reports include productivity analysis for services rendered by each practice.

The program's license allows an unlimited number of practices to be billed, with up to ten practitioners per practice, and up to 90,000 patients per practice. Program packages with licenses for AMA forms are available for medical specialties and oral surgery professionals.

(List Price: $1,595; demo disks $100)

Requires: 320K, two disk drives, PC-DOS 2.0, monitor, 130-col. printer.

CMA Micro Computer
55722 Santa Fe Trail
Yucca Valley, CA 92284
(619) 365-9718

CIRCLE 734 ON READER SERVICE CARD

Multiple-Choice Test Scoring

A program that allows a user to grade tests for any multiple-choice exam with up to 200 questions. Answers for up to 500 students taking a single exam can be graded, and test answers may be entered manually or through the use of an optical character reader.

Reports available from the software include: Statistical, showing mean scores, standard deviations, high and low scores, acceptable level of performance, and the Kuder-Richardson-20 reliability coeffient; Item Analysis Report, with individual counts and percentages for each response, percent correct, and the discrimination index for each item; Graphical Report, which shows score distribution, including the mean and acceptable level of performance; Rank Order Report, which provides a ranked order listing of all students taking the test; Individual Score Reports, which prints a separate report for each student taking the test; and a Class Results Report, printing a listing by student and performance on up to five selected tests.

(List Price: $295)

Requires: 64K, two disk drives, PC-DOS, monitor, 132-col. printer.

Ormond Software
218 Frontenac Rd.
Marquette Hts., IL 61554
(309) 382-2335

CIRCLE 777 ON READER SERVICE CARD

DOSshell

A file organization program for use with the PC/XT. The program organizes files by setting up pre-defined directories and sub-directories within a hard disk. Menus and help screens are available at all levels, and the function keys control movement through the system.

The three main trunks of *DOSshell—Applications, Utilities, User*—each have branching sub-directories. The software can support multiple users, each user having a set of personal software (appointment tracking, disk archives, phone directory, and data management). Access is controlled by password. The *Utilities* trunk has routines for controlling type styles on matrix printers, updating menus, and for adding software and new users to the system.

(List Price: $70)

Requires: PC/XT: 128K, hard disk drive, CP-DOS 2.0.

XTC
2019-C Bath St.
Santa Barbara, CA 93105
(805) 687-0865

CIRCLE 730 ON READER SERVICE CARD

CLM COGO

A computer-aiding-drafting program designed for use in civil engineering, geometrics, surveying, mapping, estimating, design, and inventory. The program features an interactive command language; the ability to maintain multiple geographic databases of classified geometric objects and spatial data in double precision coordinate fields; interactive digitizer input option; and display graphics, plot review, and plotter drafting. Full screen editing and word processing of text data is provided.

(List Price: $5,000)

Requires: 512K, one disk drive and one 10 Mb hard disk, UCSD p-System, color monitor, color/graphics adapter.

CLM/Systems, Inc.
3654 Gandy Blvd.
Tampa, FL 33611
(813) 831-7090
TWX: 810-876-9128

CIRCLE 733 ON READER SERVICE CARD

YOUR SPREADSHEETS CAN LOOK PERFECT AND STILL BE WRONG.

You know how it is.

You spend hours building up a spreadsheet. Inserting data. Changing figures. Adding new formulas suggested by others.

When you're finished, everything looks perfect. But is it?

Are those totals really right?

What formulas produced that bottom line?

Is it out? And if so, *by how much?*

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If you use VisiCalc®, Lotus™ 1-2-3* or SuperCalc™, you need The Spreadsheet AUDITOR.

Why? Because only the AUDITOR allows you to quickly and simply print out every formula in your spreadsheet.

Formulas are displayed in a two-dimensional grid that matches the layout of your spreadsheet exactly.

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So you can refer to any section instantly — identify changing patterns — and spot errors or omissions, *without* having to move your cursor from cell to cell.

For Lotus users, the AUDITOR even provides a complete listing of all named and special ranges.

Quick, simple, sure.
You don't have to waste time altering column widths. Or worry about clipping important formulas.

The AUDITOR scales columns automatically.

It gives you the option of wrapping long formulas into manageable columns that are easy to read.

A permanent record.
The AUDITOR allows you to document any spreadsheet, and create a permanent record.

It lets you examine the logic behind spreadsheets "handed down" by previous users.

And generates formats that can be followed by other users later.

Other company benefits.
In companies where several people are using spreadsheets, a series of listings can grow to become an application's library.

The AUDITOR makes sure everyone knows what spreadsheets have been developed, so no-one wastes time reinventing the wheel.

The perfect teaching tool.
The AUDITOR helps new users to learn spreadsheet building techniques quickly because it displays the formulas behind the numbers.

Printouts also show what formulas to type into any given grid location.

Put the Auditor on your side.
If you're making responsible financial or corporate decisions based on spreadsheets, you can't afford to be without the AUDITOR one more day.

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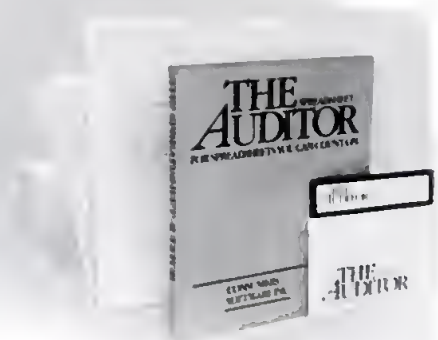

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Home Accountant Plus	150.00	84.95
Digital Research CP/M 86	65.00	44.95
Concurrent CP/M 86	350.00	278.95
Financial Personal Series	195.00	158.95

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WordStar Professional	695.00	389.95
Microrim Inc. R:base 4000	495.00	371.95
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Scitor Project Scheduler	285.00	228.95
Sorcim SuperCalc 3	395.00	318.95
Software Arts TK! SOLVER	299.00	229.95
Software Publishing PFS: File	140.00	99.95
PFS: Report	125.00	78.95
PFS: Graph	140.00	98.95
PFS: Write	140.00	96.95
SoftWord Systems MultiMate	495.00	328.95
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CIRCLE 315 ON READER SERVICE CARD

■ COMPUTER SYSTEMS ■

SuperScribe

A word processing program, featuring a separate component for letter writing capable of producing a seven-page letter keyed to a mail order file created with the main program component. In the letter mode, the user may also input any external ASCII file and store it as though it had been created within the program.

In *SuperScribe*'s manuscript mode, the size of the text file is limited only by available space in the user's system. The software allows a user to choose from one of three line spaces, and line space changes can be made at any point within a manuscript. Other features of the manuscript mode include superscript and subscript, underlining, five type faces, and automatic pagination. A screen text editor is available which may be used to switch to any part of the manuscript to perform changes to text, to move up to 72 lines of text to another location within a manuscript, or to merge text from a letter file into the manuscript.

In both modes, all cursor control functions operate the same as when editing a BASIC program. A search function can locate any designated character string, margins and tabs can be easily set or changed, and text appears on-screen as it will appear when printed.

SuperScribe is written in BASIC, and allows user modifications.

(List Price: $27.50)

Requires: 64K, two disk drives, PC-DOS, printer, color/graphics adapter, BASICA.

Cheapware
R.L. Nicolai
4038 N. Ninth St.
St. Louis, MO 63147

CIRCLE 772 ON READER SERVICE CARD

ITSoftware Series

An integrated series of programs encompassing database management, spreadsheet preparation, data communications, file transfer, editing, and data sorting and merging. The central program in the *ITSoftware Series* is *KeepIT*, a relational, menu-driven database management system without command language. *KeepIT* allows a user to move data between software modules and to transfer files to software from other manufacturers. Mailing lists and tables produced by *KeepIT* can also be used by most word processing software.

Other program modules in the *ITSoftware Series* include: *CalcIT*, a three-dimensional spreadsheet; *LinkIT*, a PC-to-mainframe and PC-to-PC asynchronous communications program; *PassIT*, a 3270 terminal emulator package compatible with the IRMA and Forte communications boards; *SortIT*, a rapid sort/search routine; and *EditIT*, a full screen editor with color windows and mouse management features.

Soon to be released in the series are *StatIT*, *ShowIT*, *SendIT*, and *WritIT* modules.

(List Price: $125-$400 per module)

Requires: 64K, one disk drive, PC DOS.

ITSoftware
P.O. Box 2392
Princeton, NJ 08540

CIRCLE 762 ON READER SERVICE CARD

PROFIN

A financial analysis program, written in Microsoft BASIC, that can automatically perform financial calculations on data entered. The software can also automatically format and print reports. *PROFIN* is designed for use by novices, requiring approximately a half-hour of practice in order to become fully conversant in the software's capabilities.

The program can produce forecasts and budgets, discounted cash flows, return on investment and capital expenditures analyses, and allows a user to experiment with sales figures, pricing, financing, inflation, foreign exchange movements, capital costs, and similar factors in obtaining comparison analyses. It also can interface with spreadsheet programs such as *VisiCalc*, *Multiplan*, and *SuperCalc* to carry out further data manipulations.

(List Price: $295)

Requires: 64K, one 320K drive, PC-DOS.

Business Software Pty., Ltd.
12021 Wilshire Blvd., #194
Los Angeles, CA 90025

CIRCLE 732 ON READER SERVICE CARD

PC-SCREEN

An interactive screen formatting utility allowing an application programmer to create, modify, file, list, and test a screen display before code is written. Applications can then do full screen I/O, or field by field I/O, through a single call to *PC-SCREEN*'s screen interface. Languages currently supported include 8088 Assembler, Pascal, COBOL, Complied BASIC, Fortran, and Lattice C.

The screen interface is an object file (.OBJ) which can be linked to the new application.

(List Price: $199; demo $35)

Requires: 64K, one disk drive, PC-DOS, monochrome or color monitor with color/graphics adapter.

Omnisoft Associates
6917 12th Ave.
Brooklyn, NY 11228
(212) 748-5763

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A product of Microrim, Inc., 1750 112 N.E., Bellevue, WA 98004

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CIRCLE 428 ON READER SERVICE CARD

***Busi*Math**, Busi*Math Corp.*

Programmer Aptitude Self Evaluation

A program that tests and grades a user's programming ability without requiring knowledge of a programming language. The *Programmer Aptitude Self Evaluation* program presents eight exercises that test a user's ability to think logically. The thought processes involved in solving the program's exercises are similar to those processes used to develop sections of computer programs. Thus, the program's evaluation can serve as an indicator of a user's ability to understand or write complex programming.

(List Price: $39.95)

Requires: 64K, one disk drive, PC-DOS.

Tridata Corp.
3057 College Heights Blvd.
Allentown, PA 18104
(215) 820-9577

CIRCLE 778 ON READER SERVICE CARD

Busi*Math

A spreadsheet enhancement program, permitting users of *VisiCalc*, *SuperCalc*, *Multiplan*, or *Lotus 1-2-3* to print out amortization schedules, as well as to custom-design solutions to a variety of loan and annuity problems. *Busi*Math* incorporates over 80 formulas that deal with all facets of the time value of money calculations. Each of the 80 formulas can be used as a spreadsheet template, and/or as algebra for incorporation with models or other templates. Formulas are referenced to single pages within the included user's manual, and can be called up and loaded into a spreadsheet model using a single command. Each variable can be entered only once to be placed in exactly the same place for each of the formulas, speeding data entry and calculations.

(List Price: $245)

Requires: *VisiCalc* version: 64K, one disk drive, PC DOS. *Lotus 1-2-3* version: 256K, two 320K drives, PC DOS.

*Busi*Math Corp.*
155 State St.
Box 361
Ripon, WI 54971
(414) 748-3422

CIRCLE 784 ON READER SERVICE CARD

Accumark PIQ System

A labor and material needs identifying program. *Accumark PIQ*, an acronym for *Production Inventory Quotation*, allows a user to project future parts requirements, permitting a company to operate profitably at minimum stocking levels.

In addition to providing parts inventory data, *PIQ* can also identify all assemblies using a particular part, how well each assembly is selling, and can report on present and future parts and labor costs. A change entered on the cost of any part is immediately reflected in the cost of every assembly using that part. *PIQ* also projects open-order situations into the future for any time period needed, submitting either a summary or detailed-report printout.

Among the software's other reports are open purchase orders, part audit trails, reorder lists, bill of materials, and detailed product costing reports. *PIQ* also can flag problem parts (i.e., extra-long lead times).

(List Price: $2,995–$3,995, depending upon user's system configuration)

Requires: 64K, one disk drive, PC DOS.

Neoteric Computer Systems
3 Seabrook Ct.
Stony Brook, NY 11790
(516) 751-4277

CIRCLE 782 ON READER SERVICE CARD

Purebred Cattle Management System

A program for purebred cattle ranchers, providing a means to maintain herd and individual breeding animal data. The software can accept data, accessible through an inquiry function, which includes performance data and ratios; progeny information; contemporary group ratios for each calf generation; pedigree and registration information; breeding activity; medical records; and purchase and sale information.
(List Price: $2,500)
Requires: 512K, two 320K drives, PC-DOS 2.0, *dBASE II*.
Arthur Andersen & Co.
801 Cherry St., #1200
Ft. Worth, TX 76102
(817) 335-3001

CIRCLE 770 ON READER SERVICE CARD

Hypergraphics

A color graphics program written in assembly and BASIC. The software can store up to 1000 color graphics screens on a single 320K diskette. In addition, most of the commands for the creation and editing of graphics and animation are assigned to function keys.

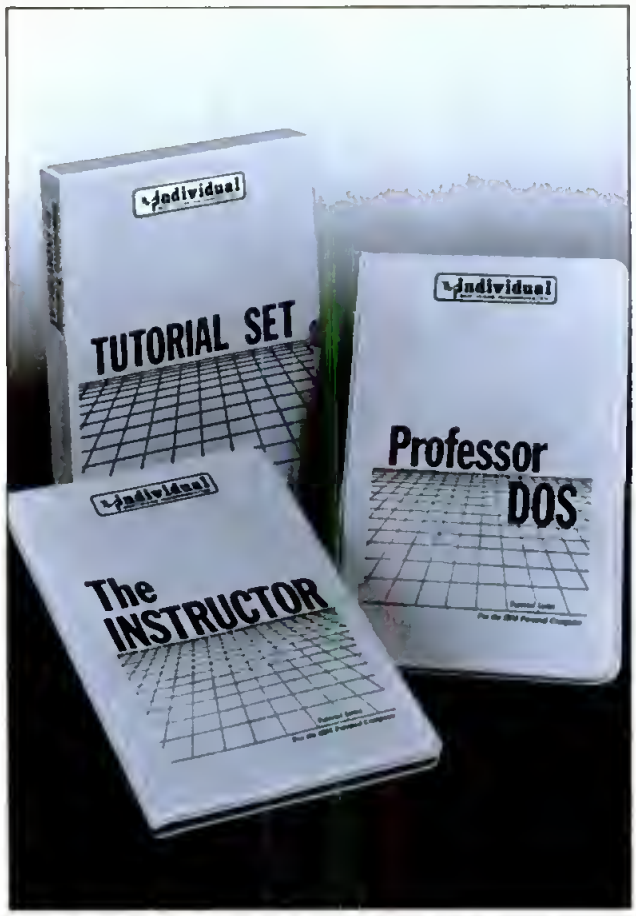
Hypergraphics can be used as an authoring language, or as an embedded component of other programs. It can also take screens from other software that have been stored on a buffer, and convert them to color graphics.
(List Price: $395)
Requires: 128K, one disk drive, PC DOS, color monitor, color/graphics adapter.
Hypergraphics Corp.
1908 Stonegate Dr.
Denton, TX 76502
(214) 783-9900

CIRCLE 761 ON READER SERVICE CARD

Tutorial Set

A package containing tutorials for PC DOS, up to version 2.0. Each tutorial simulates the DOS environment, and can guide learners of varying skill through the use of the operating system. Users are free to interact, practice, and experiment with the simulated environment.

The set includes 5 hours of training in modular form. The main menus offer sections on keyboard operations, PC concepts relating to DOS, DOS commands, application and editing functions, technical notes, and a guide to the use of EDLIN.



***Tutorial Set*, Individual Software, Inc.**

Each *Tutorial Set* contains three diskettes, available in either single- or double-sided versions.
(List Price: $94.95)
Individual Software, Inc.
24 Spinnaker Pl.
Redwood City, CA 94065
(415) 591-4166

CIRCLE 785 ON READER SERVICE CARD

HSFORTH

A hybrid compiler/interpreter/assembler optimized for 8086/8088 microprocessors, allowing the use of FORTH-79 Standard programs. Word names, definition lists, and machine codes use separate segments—thus programs may be as long as 192K without incurring the addressing penalties that usually occur above 64K. Code Definitions and List Definitions longer than a user-selected length are automatically relocated to another segment, so program use of memory above 192K incurs negligible overhead compared to long address and segment sensing schemes. Stack use and word link overhead have been reduced to theoretical limits for 8086/8088.
(List Price: $220)
Requires: 64K, one disk drive, PC DOS.
Harvard Softworks
P.O. Box 339
Harvard, MA 01451
(617) 456-3021

CIRCLE 726 ON READER SERVICE CARD

If you're using VisiCalc,® Lotus 1-2-3,® MultiPlan,® SuperCalc® or PerfectCalc,® you need an analyst.

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BottomlineV instantly produces the reports you need to see your complete financial picture

No programming required.

BottomlineV makes forecasting and modeling easy because it does hundreds of complicated calculations for you. That's right, it does hundreds of calculations. If you make a change to any part of your model, it will ripple through the entire model. Automatically updating it.

For example, suppose you want to know how an increase in sales will affect your profit picture.

BottomlineV will tell you.

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It will even give you 24 different ratio analyses that will help you better plan and run your business.

With BottomlineV, you don't have to know computer programming. You don't have to be an accountant. You hardly even have to know how to operate your spreadsheet software. Yet you will be able to see your complete financial picture. Instantly.

BottomlineV works with IBM,® Apple,® Kaypro,® DEC® and most other MS-DOS and CP/M systems.

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CIRCLE 225 ON READER SERVICE CARD

Bearings

A geographical position locating program. The user enters latitude and longitude for any spot on the globe. The software then calculates and prints out distance and direction from that spot to any of 500 cities throughout the world. Directions are given in the azimuth system, where north is 0 degrees, east = 90 degrees, south = 180 degrees, west = 270 degrees. These directions are the great circle paths as used by pilots, the shortest paths between two points.

(List Price: $19.95)

Requires: 64K, one disk drive, PC DOS.

Zephyr Services
306 S. Homewood Ave.
Pittsburgh, PA 15208
(412) 247-5915

CIRCLE 769 ON READER SERVICE CARD

Investment Return Illustrator

A program for financial planners that provides a printout showing any amount of principal invested at interest in a year-by-year format. The printout includes the name of the client and advisor, type of asset, simple and effective interest rates, cumulative return, annual interest earned, and accumulated interest earned. Investment Return Illustrator includes a feature permitting the user to choose the number of compounding periods per year.

All data is shown on a user's screen prior to printout, allowing changes.

(List Price: $19.95)
ACS Publishing Co.
P.O. Box 82363
San Diego, CA 92138
(619) 223-5331

CIRCLE 779 ON READER SERVICE CARD

PLANFIN

A forecasting, budgeting, and discounted cash flow program. The software, written in Microsoft BASIC, is menu-driven and looks at revenues, costs, and tax/depreciation factors using a question-and-answer format to produce reports. *PLANFIN* automatically produces reports in proper format without requiring additional formatting procedures.

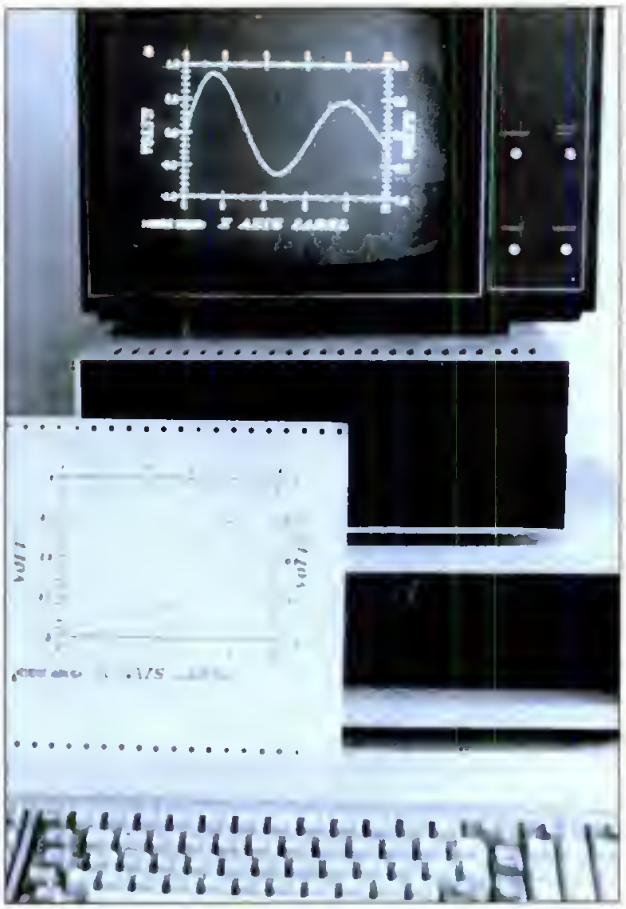
The software is designed for use by nonexperienced users, requiring approximately a half-hour of practice to become fully conversant in the software's features. In addition, it can interface with spreadsheet programs such as *VisiCalc*, *Multiplan*, and *SuperCalc* to carry out further data manipulations.

(List Price: $195)

Requires: 64K, one 320K drive, PC-DOS.

Business Software Pty., Ltd.
12021 Wilshire Blvd., #194
Los Angeles, CA 90025

CIRCLE 731 ON READER SERVICE CARD



Tele-Tek, ParaTech Corp.

Tele-Tek

An interrupt-driven terminal emulation program, providing emulation of a Tektronix 4010 graphics terminal. Features include: 9600 baud operations; various send/receive file transfer protocols, including XMODEM; menu-driven commands via function keys; and the ability to use the features of a Hayes Smartmodem.

Tele-Tek is capable of retrieving files, calling DOS for file editing (while *Tele-Tek* is still receiving new data), then exiting back to *Tele-Tek* to return files to source.

(List Price: $99)

Requires: 64K, one disk drive, PC-DOS 2.0, an asynch communications adapter, Hayes Smartmodem.

ParaTech Corp.
P.O. Box 4152
Chevy Chase, MD 20815
(202) 362-7354

CIRCLE 786 ON READER SERVICE CARD

ACCESSORIES

KLEEN LINE

A line of devices designed to suppress data-altering telephone line spikes. Used with a modem, the KLEEN LINE modem protector uses metal oxide varistor and gas discharge tube techniques to suppress line interference.

Model PDS-45P-36A/SUP has phone grade suppression on red and green lines (pins 4 and 5) and data grade suppression on yellow and black lines (pins 3 and 6). A 6500 Amp Suppressor helps to protect power lines.

(List Price: $109.95)
Electronic Specialists, Inc.
171 S. Main St.
P.O. Box 389
Natick, MA 017760
(617) 655-1532

CIRCLE 754 ON READER SERVICE CARD

Printer Bench

Two tabletop printer stands which elevate a printer 4½ inches above a work surface, permitting paper to be stored underneath. The units are designed to work with either rear or bottom feeding printers, with either 9½ or 15 inch paper capability.

Skid resistant rubber feet minimize vibrations for quieter operation of the printer.

(List Price: 9½-inch model $19.95; 15-inch model $24.95)
Valley Craft, Inc.
So. Highway 61
Lake City, MN 55041
(800) 328-1480

CIRCLE 753 ON READER SERVICE CARD

Le SWITCH

A switching device, allowing two printers to be run from the same computer. Available in both parallel and serial versions, Le SWITCH enables a user to switch between dot-matrix and daisywheel printers, for example, via a simple hookup.

Le SWITCH I (for parallel printers) consists of a female parallel connector for input, and male parallel connectors at the ends of two ribbon cables for output. Le SWITCH II (for serial printers) features three female DB-25 connectors compatible with a range of RS-232 computers and printers. A modem can also be installed on one of Le SWITCH II's serial ports.

(List Price: Le SWITCH I $155; Le SWITCH II $125)
Renaissance Technology Corp.
1045 Detroit Ave.
Concord, CA 94518
(415) 676-5757

CIRCLE 760 ON READER SERVICE CARD

PCase Shipping Cases

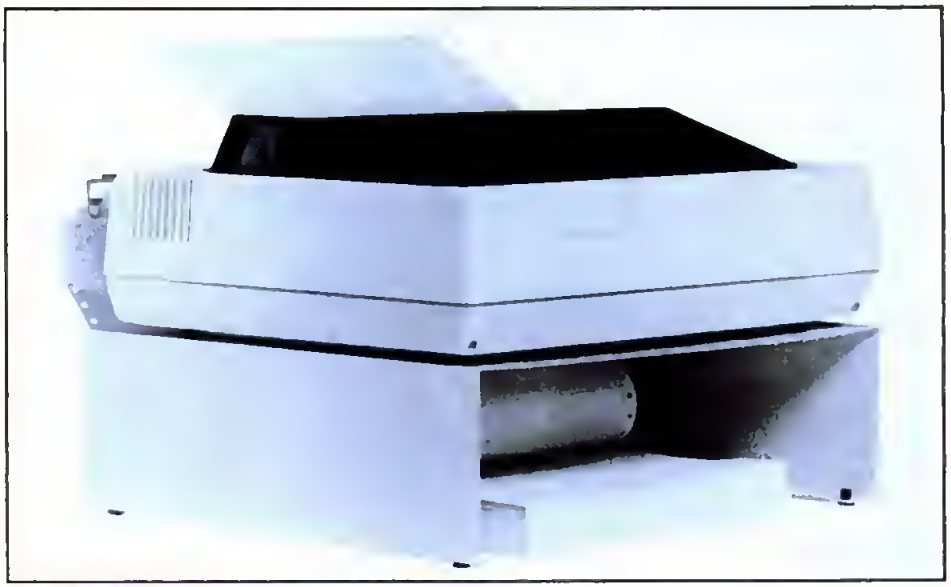
A line of all-metal shipping cases, with fitted compartments for the components of a user's system. The cases, constructed of heavy-duty sheet aluminum, are splinterproof, fungus-proof, and resist moisture and puncturing. Edges are epoxy-sealed continuous channels formed in one-piece aluminum extrusions. Exteriors are completely finished with a durable epoxy/acrylic paint.

Case interiors are lined with layers of high density polyfoam, and blocks of polyfoam are used to surround all components. The top cover comes completely off for access to all components when packing.

Additional features include welded-on handles, lockable latches, an exterior shipping document carrier, and optional removable casters.

(List Price: $346-$495, depending upon model and size; caster base $34)
PCase, Inc.
60 Orville Dr.
Bohemia, NY 11716
(800) 231-CASE
(516) 567-5800

CIRCLE 755 ON READER SERVICE CARD



***Printer Bench**, Valley Craft, Inc.*

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WildCard 2 (formerly The Alaska Card)

Designed by us and produced by Eastside Software, WildCard 2 is the easiest-to-use, most reliable card available. Making backups of your total load software can be as easy as pressing the button, inserting a blank disk and hitting the return key twice. WildCard 2 copies 48K, 64K and 128K software, and, unlike other cards, is always ready to go. No preloading software into the card or special, preformatted diskettes are required. Your backups can be run with or without the card in place and can be transferred to hard disks. $139.95 complete.

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These products are supplied for no other purpose and you are not permitted to utilize them for any other use, other than that specified.

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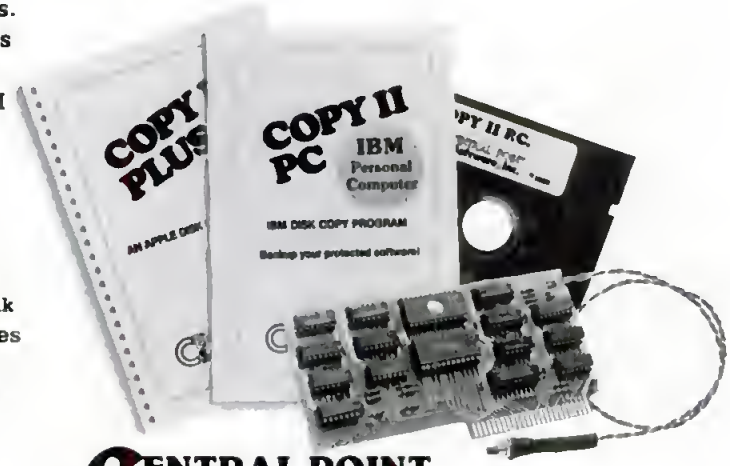
This is THE disk backup program for the IBM PC, PC/XT and PCjr that copies almost anything. Others may make similar claims, but in reality, nothing out performs Copy II PC...at any price. Copy II PC even includes a disk speed check and is another "best buy" at only $39.95. Specify machine when ordering.

We are the backup professionals. Instead of diluting our efforts in creating a wide variety of programs, we specialize in offering the very best in backup products. So, protect your software investment, **before** the I.R.S. gets you.



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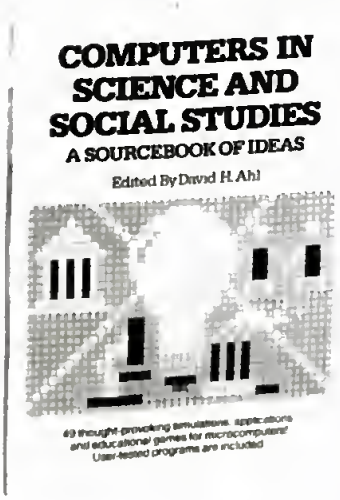

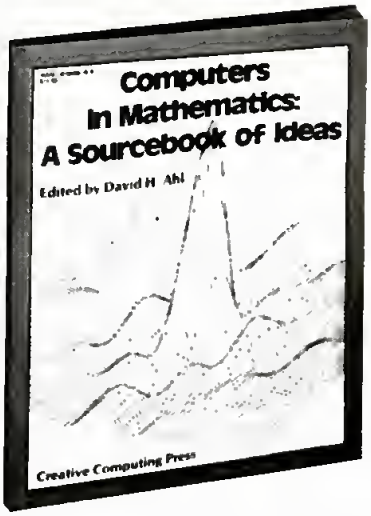

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The Wire Away, Networx

The Wire Away

A power cord storage device, able to conveniently store up to four 18-gauge power cords. The device accommodates up to 14 feet of power cords wrapped around four posts within the unit, which are then concealed behind a snap-on lid. Four screws attach the unit to the underside of a workstation or desk.

(List Price: $12.95)
Networx
203 Harrison Pl.
Brooklyn, NY 11237
(212) 821-7555

CIRCLE 756 ON READER SERVICE CARD

Data Spec RS-232 Cables

A line of high-quality data cables, featuring fully shielded 25 conductor leads with RS-232 connectors. The cables are available in lengths from 3 feet to 25 feet.

At each connector end, wires are first soldered in place, then molded over with PVC to withstand vibrations and shocks. A shield within the connector assures shield coverage over the entire length of the cable.

(List Price: $29.95-$55.95, depending upon length)
Ora Electronics
18215 Parthenia St.
Northridge, CA 91325
(213) 701-5848

CIRCLE 758 ON READER SERVICE CARD

EndStat

A device eliminating static electricity from the air around a user's system. EndStat creates both positive and negative ions which attract stray static charges of the opposite polarity.

The device envelops an area of approximately 35 square feet.

(List Price: $199.95)
Lifetronic Purification Systems
P.O. Box 3023
Covina, CA 91722

CIRCLE 759 ON READER SERVICE CARD

PUBLICATIONS

Electronically Speaking

A guide to current technology and circuitry for computer speech synthesis. *Electronically Speaking: Computer Speech Generation,* by author John P. Cater, presents the available hardware and software that permit personal computers to synthesize speech.

(230 pgs., $14.95)
Howard W. Sams & Co., Inc.
4300 W. 62nd St.
Indianapolis, IN 46268
(317) 298-5400

CIRCLE 751 ON READER SERVICE CARD

Computer Novelties Catalog

A catalog listing a variety of novelty items relating to personal computer use. Items include silk-screened clothing, jewelry, bumper stickers, decals, coffee mugs, greeting cards, as well as items for office use, such as paper weights, calendars, diskette holders, posters, etc.

($1.00, postage and handling)
Computer Novelties, Inc.
504 Wildwood Dr., #100
Durham, NC 27702
(919) 477-0306

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A handbook on C programming, with chapters on program looping, decision-making, arrays, program structures, character strings, and working with larger programs. *Programming in C,* by Steven G. Kochan, also incorporates a comprehensive summary of the language, lists of commonly made mistakes to avoid, and the calling sequences for many of the functions included in the UNIX Standard C Library. Test exercises conclude each chapter.

(384 pgs., $18.95)
Hayden Book Co., Inc.
50 Essex St.
Rochelle Pk., NJ 07662
(201) 368-2202

CIRCLE 750 ON READER SERVICE CARD

A Beginner's BASIC Link

A book written for children in grades 4, 5, and 6, who are participating in a computer literacy class. *A Beginner's BASIC Link* introduces the reader to computers, flowcharting, and elementary BASIC programming. Activities and practice assignments are included throughout the book.

(List Price: $8)
Diversified Educational Enterprises, Inc.
725 Main St.
Lafayette, IN 47901
(317) 742-2690

CIRCLE 749 ON READER SERVICE CARD

Word Processing for Small Businesses

A handbook detailing the products, problems, and opportunities present in establishing a word processing system within a small business. The book, by author Steven F. Jong, describes the elements of word processing systems, discusses the decisions that need to be made prior to purchasing such a system, and explains options with advice on choosing a system. Detailed information is provided on more than 50 hardware and software products available for dedicated and non-specialized systems.

Included in *Word Processing for Small Businesses* are performance checklists, a sample service contract (for after-sale support), charts for comparisons of similar products, and discussions of what lies ahead in personal computer word processing.

(List Price: $11.95)
Howard W. Sams & Co., Inc.
4300 W. 62nd St.
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(317) 298-5400

CIRCLE 752 ON READER SERVICE CARD

***Word Processing Guide**, Sams & Co., Inc.*

SERVICES

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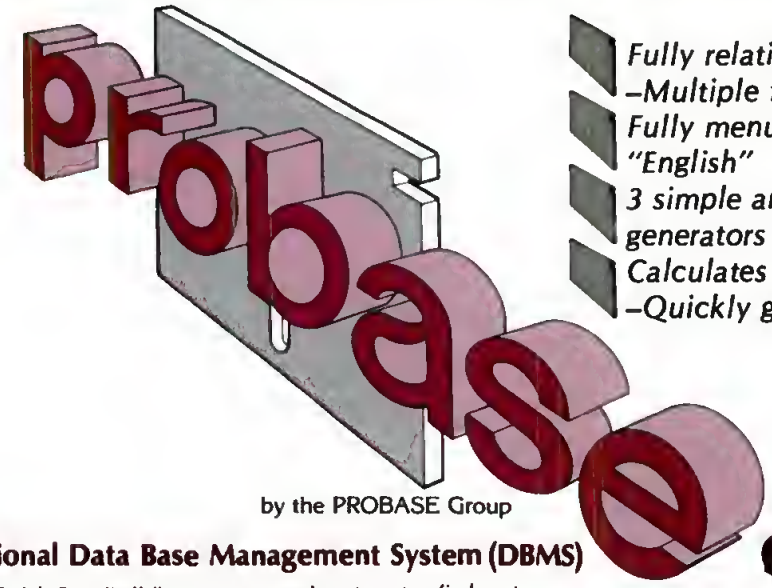

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CIRCLE 106 ON READER SERVICE CARD

EDITED BY PAUL SOMERSON

User-To-User

PC readers use this forum to help one another by passing along their questions, solutions, comments, and complaints.

Sloppy Floppies

Here's a DOS 2.X "why didn't I think of this before" trick that's incredibly easy and useful. It will sort and keep track of all files on your floppy disks and let you locate any file in seconds.

You'll need DOS 2.0 or 2.1 and a word processor. My personal favorite is still *WordStar*, but you can use any word processor that can do string searches.

First, number all your disks—on their labels. DOS versions 2.0 and higher allow redirection of I/O, which will put the directories of each disk into individual files. To do this, get into DOS, put a blank, formatted disk into drive B:, put your disk #1 into drive A:, and type in:

```
(DIR A:>B:DISK1)
      [then hit the ENTER key]
```

(If you're already logged into drive A: you can simply type DIR>B:DISK1. And if you want to keep the master file on your hard disk, type DIR A:>C:DISK1.)

Then put disk #2 in, and type:

```
DIR A:>B:DISK2
      [then hit the ENTER key]
```

You don't even have to type in this whole command each time. Just hit function key F3, which will repeat the previous DOS command, then backspace once or twice to erase the "1" in DISK1 and type in a "2," and hit the ENTER key. Then hit F3 again, backspace to erase the "2," and type in a "3," and so on.

When you're all done, you'll have a lot of directories on drive B: named DISK1, DISK2, DISK3. . . . Append them into one master file by typing in:

```
COPY B:*.  DIRECTRY
```

This will merge all of the individual directory files into one master file called DIRECTRY.

All you have to do now is go into that master DIRECTRY file with your word processor, number the individual directories sequentially, and clean them up if you don't want to see the "bytes free" messages or the "Volume in drive A has no label" messages.

To find what disk a file is on, use your word processor's string search command

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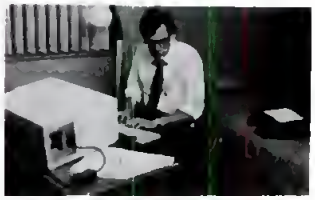

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(^QF in *WordStar*) to hunt for the filename. Scroll up through the individual listing, once *WordStar* has found a match, to see what the number of the disk is. You can find all sorts of uses for this. For instance, you could see if copies of a file are on more than one disk, or look at every file that you created or modified last Tuesday, and so on.

When you change the contents of any of the files on one of the disks listed in your master directory, you have to redirect the changed disk's directory into a temporary file, then get into the master directory and delete the old listing and read in the temporary file. You can do this in *WordStar* in about a minute with block moves (^KB^KK^KY to remove the old directory, then ^KR to read in the new one).

You might also be able to use DOS FIND and SORT filter commands for this, but if you do so, you'll have to use your word processor to add the number of the disk to each line in each of your directory listings.—*P.S.*

LOF Bug

Here is a bug in BASICA that I sent to IBM months ago. Their Product Comment Form implies that they reply to such constructive inputs. I wonder if any of your readers has ever received the courtesy of a reply? The bug is as follows:

If a random file is written with more than 2**15 bytes, then the LOF function will return a false value unless the file is first closed and then reopened.

A brief test program is enclosed (see Figure 1). Note that the first value returned for LOF(1) is false and BASICA issues no warning about this. This one really nailed me. I hope it may help someone else.

Richard Moran
Tecumseh, MI

While this is indeed a nasty bug, your solution is fairly simple and painless. Users can simply add a single line that both closes and then reopens the file.

Text File Cleaner

I've devised a simple method of viewing and deleting unwanted text files using DOS 2.0 (see Figures 2 and 3).

I've assumed in this example that BASICA.COM, CLEAN.BAT, and CLEAN.BAS are on the A: drive. The user must first enter the directory to be cleaned. The CLEAN.BAT batch file is then executed by typing:

CLEAN filename.ext
(i.e. CLEAN *.DOC)

The batch program then:

- Redirects a directory output of specified files to the file DIR.DIR
- Executes CLEAN.BAS
- Deletes the DIR.DIR file

The BASIC program CLEAN.BAS (in

```
100 ' Program to test the LOF function -- by Richard Moran
110 OPEN "SINK" AS #1 LEN=46
120 FIELD #1, 46 AS A$
130 LSET A$=STRING$(46,65)
140 PRINT A$
150 FOR Z=1 TO 1000
160 PUT #1,Z
170 NEXT Z
180 PRINT LOF(1)
190 CLOSE 1
200 OPEN "SINK" AS #1 LEN=46
210 PRINT LOF(1)
220 CLOSE 1
230 END
```

Figure 1: *A test program for the LOF bug.*

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Figure 2) opens the DIR.DIR file and reads in the filenames one at a time. The filename is displayed, and the user is asked if the file should be viewed. If the letter Y is entered, then the file is displayed. The user is then asked if the file should be deleted. This continues for all files with the selected filename or extension.

Preston S. Powell
Streetsboro, OH

This works with DOS 2.0 or 2.1 text (ASCII) files only. If you try to view a .COM or an .EXE file, or a .BAS file saved in binary format (i.e., without an ",A" after the filename), you'll end up with a screen full of garbage. Other than that, CLEAN.BAS works like a charm.

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Furthermore, all programs that create .COM or BSAVE'd executable code from decimal or hex data must be accompanied by the source code in assembly language. This, too, will reduce errors and will be instructive to readers of User-To-User. ■

```
100 ' CLEAN -- by Preston S. Powell
110 OPEN "DIR.DIR" FOR INPUT AS #2
120 IF EOF(2) THEN SYSTEM
130 INPUT #2,A$
140 IF INSTR(1,A$,"-")=0 THEN 120
150 A$=MID$(A$,1,12)
160 G$=LEFT$(A$,8)+"."+MID$(A$,10,12)
170 CLS
180 PRINT G$:INPUT "Do you want to view";C$
190 IF C$="Y" OR C$="y" THEN 210
200 GOTO 270
210 OPEN G$ FOR INPUT AS #1
220 IF EOF(1) THEN 260
230 INPUT #1,B$
240 PRINT B$
250 GOTO 220
260 CLOSE #1
270 INPUT "Do you want to delete";C$
280 IF C$="Y" OR C$="y" THEN KILL G$
290 GOTO 120
```

Figure 2: *CLEAN.BAS Text File Cleaning program.*

```
echo off
dir %1>dir.dir
a:basica a:clean
del dir.dir
```

Figure 3: *DOS 2.0 CLEAN.BAT batch file to run text file cleaning operation.*

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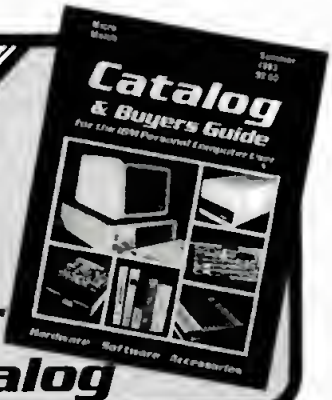

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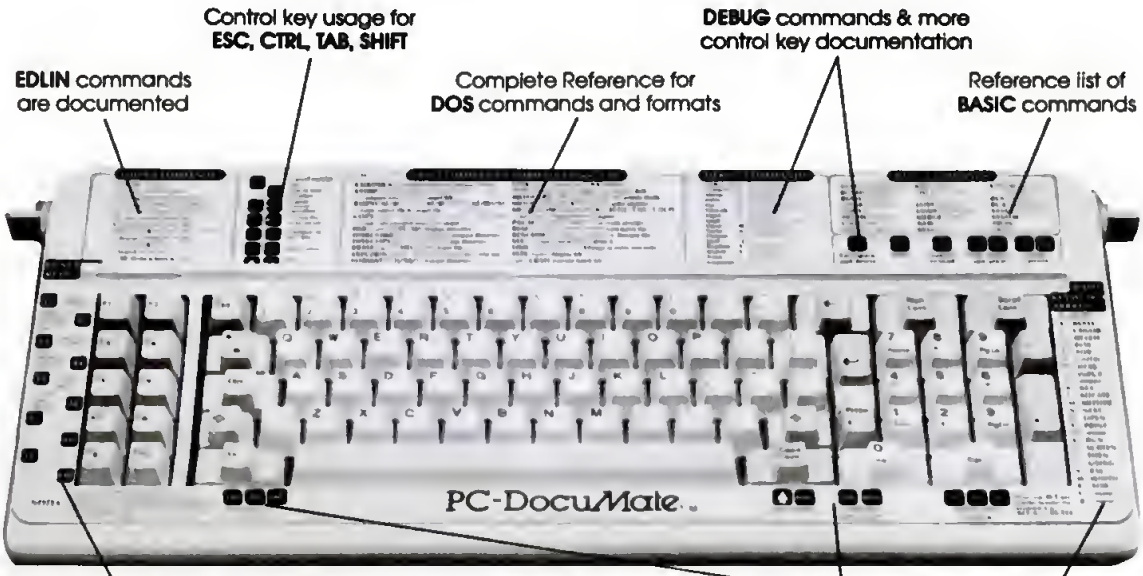

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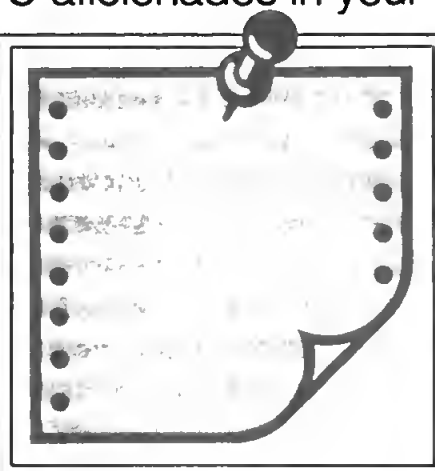

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Phoenix IBM-PC Users Group
P.O. Box 44218
Phoenix, AZ 85064
(602) 954-7519

CALIFORNIA

Stanford/Palo Alto User Group
c/o Linda de Sosa
P.O. Box 3738
Stanford, CA 94305
(415) 856-6281

San Diego Computer Society
c/o John Field
1384 Caliente Loop
Chula Vista, CA 92010
(619) 421-9686

IBM PC User Group
c/o Lee Wersel
7255 Orchard Dr.
Gilroy, CA 95020

Modesto-Turlock IBM PC User Group
P.O. Box 5122
Modesto, CA 95352

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c/o Neil Zachary
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Los Angeles, CA 90078
(213) 937-1314

North Orange County IBM Club
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Placentia, CA 92670
(714) 996-4464

PC will publish a periodic listing of PC user groups and their activities. Drop a line to Club News, *PC*, One Park Ave., New York, NY 10016. New groups and address changes are shown in **boldface.**

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c/o Alfred Hunt
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Walnut Creek, CA 94596
(415) 687-8037

Cubic Computer Club
c/o Pete Nelson
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San Diego, CA 92138
(714) 453-4953

San Francisco IBM PC User Group
4411 Geary Blvd., #33
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Marin/Sonoma IBM-PC Users
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Corte Madera, CA 94925
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c/o CMA Personnel Inc.
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School of Nursing
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U.C., San Francisco
San Francisco, CA 94143
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Pomona Valley IBM PC User Group
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10282 Felipe St.
Montclair, CA 91763
(714) 624-9194

Bay Area User Group
c/o Christian Du Lac
P.O. Box 155
San Francisco, CA 94101
(415) 668-4647

Silicon Valley Computer Society
c/o Elvin H. Bollet
P.O. Box 60506
Sunnyvale, CA 94088
(408) 243-1154

San Fernando IBM PC Users Group
c/o David Nussbaum
11558 Riverside Dr., #207
North Hollywood, CA 91602

Peninsular IBM PC Users Group
c/o Friendly Software Corp.
376 El Camino Real
San Carlos, CA 94070

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P.O. Box 1937
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Thousand Oaks, CA 91362

Rancho California Computer Club
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Temecula, CA 92390

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Fresno IBM-PC Users Club
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6750 N. Woodrow Ave.
Fresno, CA 93710

Redding Area PC Society
c/o Ken Daniels
2516 Park Marina Dr., #6
Redding, CA 96001
(916) 243-4411

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c/o Steve Leibson
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Boulder, CO 80303
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Colorado Springs IBM-PC User Group
c/o Cleveland Bell
P.O. Box 16256
Colorado Springs, CO 80935

Front Range PC User Group
c/o Joan Brown
813 Engleman Pl.
Loveland, CO 80537
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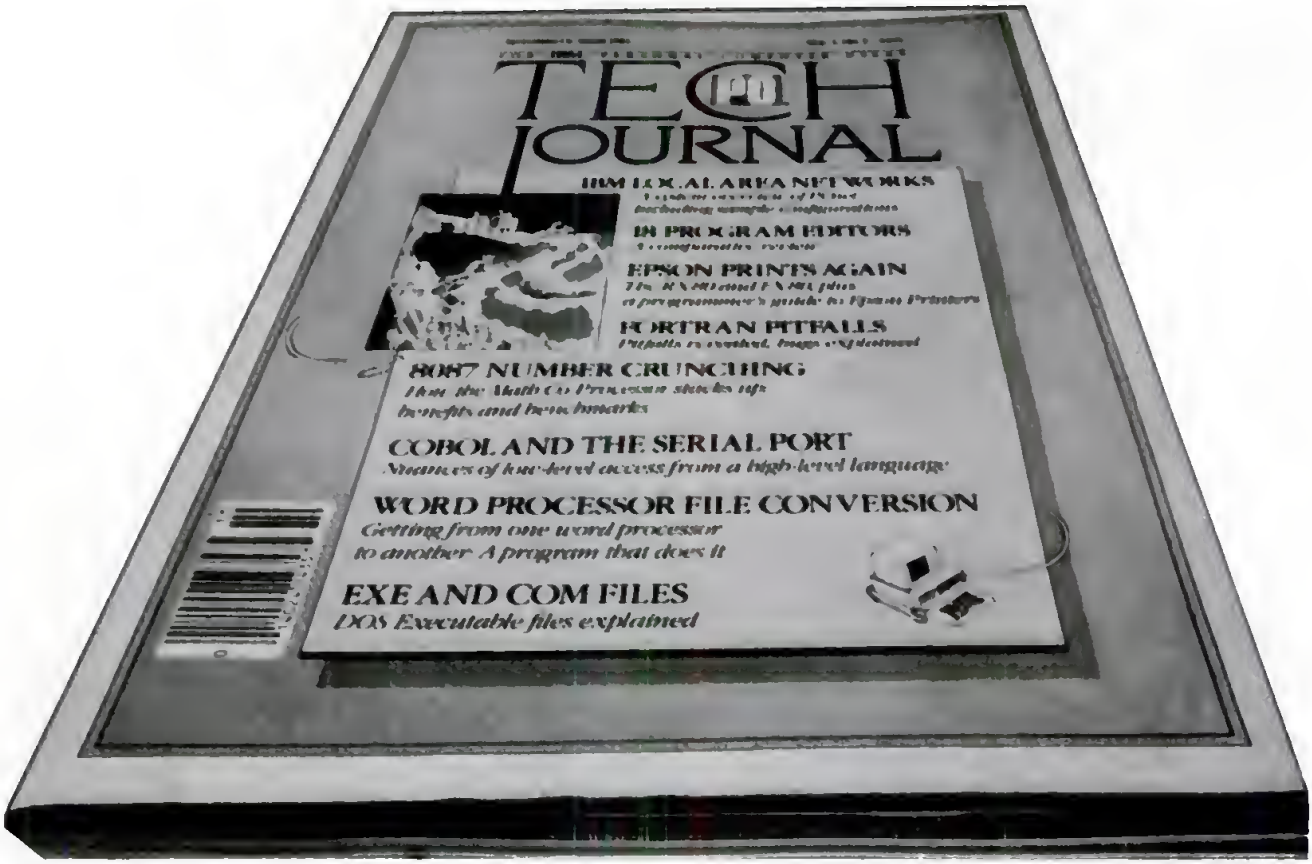

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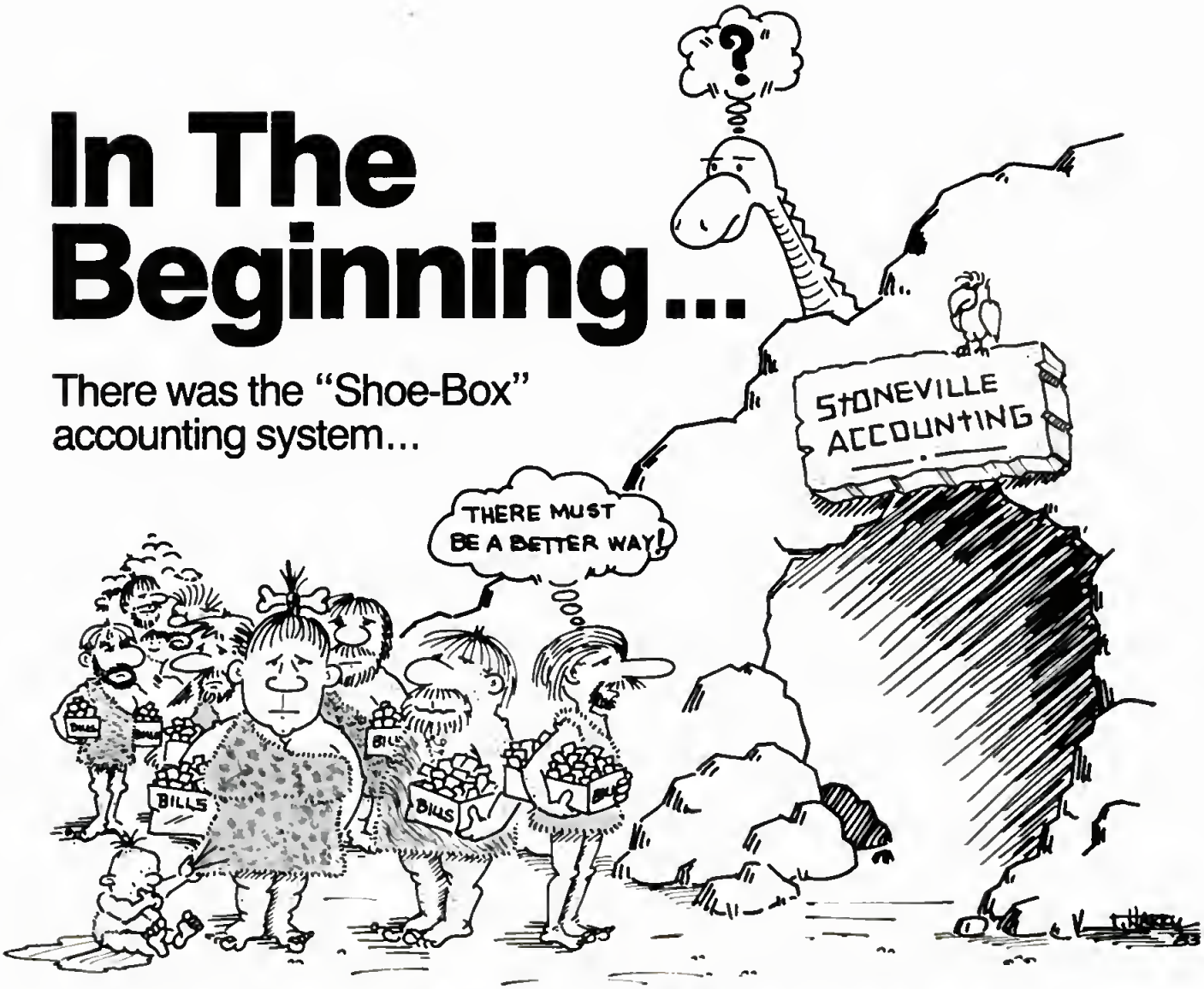

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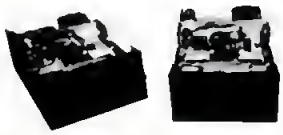

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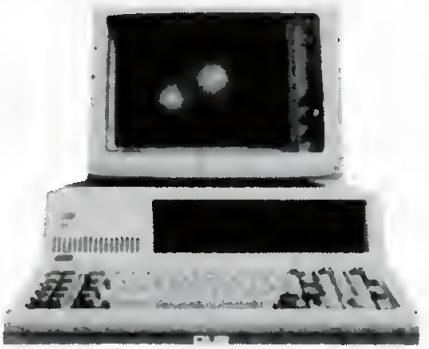

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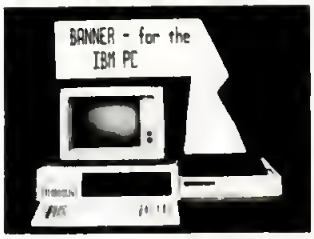

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Hands Off DISKCOPY

Q: I wrote an AUTOEXEC.BAT file that sets up a RAM disk, then uses DISKCOPY to copy the boot-up disk into the RAM disk. But the DISKCOPY program prompts me twice: first to press any key when ready, then to ask if I want to copy another disk. Is there any way (short of using COPY *.*) to avoid having to key in the two entries myself?

John L. Cofer
Knoxville, Tennessee

A: *The hard way would be to patch the DISKCOPY program itself. A simpler approach, if you have PC-DOS 2.0, is to use redirected input (see page 10-4 in the DOS 2.0 manual).*

Just create a file containing the keystrokes you need (in this example I'll call it RDY), then use redirection to call on this file when you run DISKCOPY. To create the file, enter these two lines in response to the A> prompt:

```
A>COPY CON: RDY
.N
```

Then enter Ctrl-Z to return to the A> prompt.

Now you have the RDY file, which contains a period (.) that responds to the "press any key when ready" prompt, and an N that signals that you don't want to copy another disk.

Once you've created a file with the keystrokes you need, use a statement with this syntax in your AUTOEXEC.BAT file:

```
DISKCOPY A: C: <RDY
```

This statement will copy RDY file from A: to C: without operator intervention.

Assembling Precision Numbers

Q: I program in both BASIC and assembly languages. My problem is that I don't know how to use assembly language to interpret single- and double-precision numbers that were created for BASIC random-access disk files.

Robert Svenson
Barrington, Illinois

A: *As far as I can determine, real numbers and integers are both written to random files as character strings. BASIC statements with WRITE # or PRINT # create strings that appear in the same form as the numbers would be printed, including characters for exponential notation, decimal points, and minus signs. In files of this sort, the numbers are delimited with carriage return/line feed pairs, which separate records, and also by commas, which*

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separate the fields in a record.

To decipher a number stored in one of these files, you need to write a routine that translates the various characters into a real number. It would be simpler to work with numbers in files that were created by INPUT # statements.

Real numbers and integers are both written to random files as character strings.

It's a different situation if you are asking about interpreting numerical arguments, in machine language, that were obtained through CALL statements. (See page C-10 of the IBM BASIC manual.) When a machine language subroutine is called from BASIC, the addresses of the arguments are pushed onto a stack. If your program begins by pushing BP, then moving SP to BP, the address of the last variable on the list is stored at [BP]+6. The address of the variable before that is stored at [BP]+8, and so forth. For example, when this BASIC statement is executed,

```
CALL SUBRT(A%, B$, C)
```

you can find the address of real number C (the last of the variables) stored at [BP]+6, the string descriptor for B$ at [BP]+8, and the address of integer A% at [BP]+10.

In a USR subroutine, unlike the CALL subroutines, you can only pass one argument. (See page C-14 in the IBM BASIC manual.) In this case, register AL will identify the variable's type and DS:BX will contain its address. Since there is this difference in the way the addresses of the variables are found when using CALL or USR, I'll refer to argument pointer as "ptr" in the following examples so that the explanation will apply in both cases.

In these explanations, I'll follow the assembly language convention of using parentheses, so (nnn) means the value stored at address nnn, and (nnn+1) means the value stored at address nnn+1.

If 2 is the value of the byte that identifies the argument type, the argument is an integer. The value of this integer is:

```
256*(ptr+1) + (ptr)
```

If the value 3 identifies the argument type, the argument is a string. The string is (ptr) bytes long and begins at this address:

```
DS : (256*(ptr+1) + (ptr))
```

The value 4 identifies a single-precision argument, which is a real number stored as two different values—an exponent and a mantissa:

```
real number =
  mantissa * 2^exponent
```

The value of the exponent is

```
(ptr+3) + 128
```

and the mantissa is

```
.5 + (7Fh AND (ptr+2))/256 +
(ptr+1)/256^2 + (ptr)/256^3
```

If (80h AND (prt+2)) is true, then the real number is a negative number.

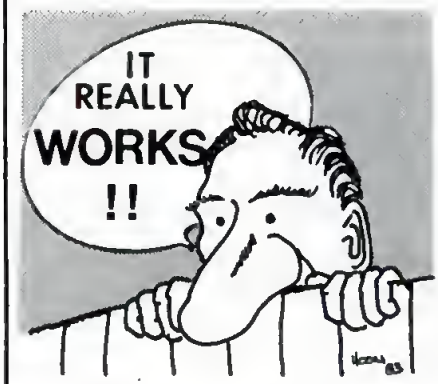
If the argument identifier byte is 8, the argument is a double-precision real number. With this type of argument, the CALL and USR routines have different pointer definitions. If CALL is involved, treat the argument pointer ptr as ptr+4. The exponent is handled in the same way as with single-precision arguments. The value of the exponent is

```
(ptr+3) + 128
```

The mantissa of the double-precision argument is stored in 4 more bytes than are used for a single-precision number. The mantissa equals

```
.5 + (7Fh AND (ptr+2))/256 +
(ptr+1)/256^2 + (ptr)/256^3 +
(ptr-1)/256^4 +
(ptr-2)/256^5 +
```

(continued)



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```
(ptr-3)/256^6 +
(ptr-4)/256^7
```

Again, if (8ØhAND(ptr+2)) is true, then the double-precision real number is negative.

Most power converters for travelers are too light duty for the PC.

Update on Foreign Powers

According to Marvin Konopik, a reader in Indonesia, the IBM PC works fine with a line frequency of 50Hz, such as is found overseas. This does not mean you should use a 220 volt line, but 110 or 120 volts at 50Hz seems to work fine. Most power converters for travelers are too light duty for the PC, but transformers are available that can handle the PC's load.

Saving Hi-Res Pictures

Q: The Apple computer has a BSAVE command to digitize and save high-resolution pictures and to recall them. Can I do the same on the IBM PC?

Scott D. Pakin
Chicago, Illinois

A: *The IBM PC has a BSAVE command that can be used for the same purposes. Since the color/graphics adapter is located at segment &hB800 you would use the following BASIC program to save the picture, which requires 16,000 bytes (80 bytes per line multiplied by 200 lines).*

```
1000' save a screen to disk
1010 DEF SEG = &hB800
1020 BSAVE ''PICTURE'',0,
/&h4000
```

Now use this program to redraw the picture on the screen.

```
1000' retrieve a previous
picture
1010 DEF SEG = &hB800
1020 BLOAD ''PICTURE'',0
```

The Defeated Feeder

Q: I bought an Epson MX-80 F/T printer to go with my IBM PC because I needed the friction feed option for single sheets of paper. So far I have not been able to make this option work successfully. Every time I insert a single sheet of paper or an envelope, the out-of-paper buzzer turns on. Even when I turn off the buzzer switch in the printer, the paper feeder still stops.

How can I turn off the out-of-paper switch to print one sheet at a time with *EasyWriter* and BASIC?

Gregory S. Slutz
Singapore

A: *Turning off the buzzer may stop the sound, but it will not stop the printer from sending a signal to the computer when there is no paper left. In order to stop the signal, you need to convince the printer that there is still paper left. That can be done by taping the out-of-paper switch flat against the chassis. If you trace through the route that the paper follows, you will find a small switch. That's the out-of-paper switch. You should tape it flat.*

According to the manual for my Epson FX-80 (which is generally like the MX-80 with Graftrax), sending an Esc-8 will turn off the paper-end detection. If Esc-8 works on your printer, you can probably solve your problem by running the following BASIC program

```
ESC$ = CHR$(27) :
  LPRINT ESC$+"8";
```

This will disable the paper-end detection. Note that the printer is reset whenever you load BASIC, so sometimes you may need to run the above line again.

The PC Tutor solves practical problems and explains points of general interest. If you'd like to see your questions answered here, drop a line to PC Tutor, PC Magazine, One Park Avenue, New York, NY 10016.

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MUMPS: A Cure For Swollen Programs

The MUMPS programming language, now available for PC users, combines versatility and economy.

MUMPS is a computer language, not a disease. The name conveys its medical origin: it's an acronym for Massachusetts General Utility Multi-Programming System, which was developed for minicomputers at Massachusetts General Hospital in 1972. A public-domain version for the IBM PC, called Micro-MUMPS, is now available from the University of California. Now, after several revisions, Micro-MUMPS is an almost bug-free implementation of what I believe is the most efficient programming language on the market. (For information on medical applications of the MUMPS language, see "MUMPS Fever," in this issue.)

The economy of the MUMPS language was pointed up at a recent systems seminar that was attended largely by COBOL programmers. The participants were asked to rough out a section of code for a file-handling function. While most of the routines written in COBOL required over 40 lines of code, my routine, written in MUMPS, amounted to only seven lines. Many of the programmers were surprised at the power of this little-known language.

The program I wrote, called DEMO (see Figure 1), allows you to create and display names and addresses on a mailing list. To understand how MUMPS works, you should first familiarize yourself with the MUMPS commands used in this program:

```
W = WRITE    Q = QUIT
S = SET      I = IF
F = FOR      $N = NEXT
D = DO       $P = PIECE
Exclamation point (!) =
CARRIAGE RETURN/LINE FEED
PAIR
Apostrophe (') = NOT or
UNDEFINED OR NULL VALUE
```

The Input Routine

The DEMO program creates a global file, called ^MAIL, that stores mailing list names and addresses. (All global file names are preceded by a caret.) When you want to enter new records, start from PC-DOS, load the Micro-MUMPS interpreter, and then load the DEMO program by

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typing the following:

```
D IN^DEMO
```

The prefix IN causes execution of the program to begin at the line labeled with that name. This line sets up a variable array, with variables P(1) through P(5), and also causes prompts for name, street address, city, state, and ZIP code to appear on the screen.

> The INTAK line in this MUMPS program accomplishes the entire file access and setup procedure.

The next line of the program, labeled LOOP, causes the subroutine in the next line, called INTAK, to be executed until the value of the FLG variable is 1. The inner loop, on the second line of INTAK, prompts you to enter data for variables P(1) through P(5) and then transfers this data into a second array, D(1) through D(5). The data finally is added to the global ^MAIL file.

In MUMPS, an underscore (_) is the concatenation operator, which strings together the variables along with the delimiter (the caret symbol) between each variable. Since a global file entry may be up to 255 characters in length, there's enough space to link the variables as a single unit. Figure 2 shows the ^MAIL file after the first two sets of data were entered.

The INTAK line in this MUMPS program accomplishes the entire file access and setup procedure. Once the file is started, the B-tree file manager maintains all entries dynamically in ASCII-collated sequence. This means that your files are automatically sorted as you build or update them. The two records in Figure 2 would be stored in alphabetical order even if I had entered the data for "Allen, Frank B." after "Name, Fake" was already in the file.

The subscript area of a code name is collated on a character-by-character, left-to-right basis. Since the only limit on the number of subscripts is that the node name must fit into a 255-character space, it's practical to use MUMPS to automatically sub-sort any body of data by subscripting each entry as desired and storing them in a global file.

```
DEMO    ;CALL AT 'IN' OR 'OUT' // DPP // 1983
        ;
IN      S P(1)="Name",P(2)="Street",P(3)="City"
        S P(4)="State",P(5)="Zip",FLG=0,L="^"
LOOP    F I=1:1 D INTAK Q:FLG=1
        Q
INTAK   F J=1:1:5 D PRNT I J=1&('D(J))
        Q:FLG=1
        S ^MAIL(D(1))=D(2)_L_D(3)_L_D(4)_L_D(5) Q
PRNT    W !,"ENTER "_P(J)_" : " R D(J) Q
        ;
OUT     S NM="-1"
        F I=1:1 S NM=$N(^MAIL(NM)) Q:NM="-1"  D DISP
        Q
DISP    F P(1)=NM W ! F DATA=^MAIL(P(1))
        F J=2:1:6 S P(J)=$P(DATA,"^",J-1)
        F J=1:1:5 W !,P(J)
        Q
```

Figure 1: *A sample MUMPS program, called DEMO, creates and displays a mailing list with only seven lines of code.*

```
^MAIL(Allen, Frank B.)=112 Elm Rd.^Union^SC^11111
^MAIL(Name, Fake)=222 Oak Dr.^Athens^GA^22222
```

Figure 2: *The DEMO program creates this global file, called ^MAIL, which contains the first two data nodes entered in the program.*

MUMPS doesn't care whether the arrays it works with are dense or sparse with data. For example, if there was no value for one of the variables, such as D(3), the MUMPS interpreter would set a null value in its files rather than crash the program.

The Output Routine

The line labeled OUT is the other point where you can enter into the DEMO program. When you type this line:

```
D OUT^DEMO
```

the MUMPS interpreter loads DEMO and starts execution from the OUT line. The first action is to set a name variable (called NM) to a value of −1. Then the display process begins through a FOR (F) loop that uses the NEXT ($N) function to step through a file node by node. I defined the start node to be ^MAIL(NM), which is initially ^MAIL(−1). Even though a data node with this name wasn't defined in the file, there's no problem. On the first pass through the loop the $N (NEXT) function will increment NM to the value Allen, Frank B., which is the first defined file subscript with an ASCII value higher than −1, the initial value of NM. The next time through the loop, NM will be set to Name, Fake, and so on. When there are no further entries in the file, NM is reset to the value −1 and the Q (quit) command terminates the loop.

> The B-tree file manager maintains all entries so your files are automatically sorted as you build or update them.

```
Allen, Frank B.
112 Elm Rd.
Union
SC
11111

Name, Fake
222 Oak Dr.
Athens
GA
22222
```

Figure 3: *Data from the ^MAIL file as it is formatted and displayed through the OUT and DISP lines of the DEMO program.*

As long as NM has a value greater than −1, the subroutine called "Disp" is performed on each repetition of the loop. This subroutine takes information, places it into the variable called DATA, and then puts the information into the correct display format using the ,$P function, which "pieces up" the variables. Figure 3 shows how the DEMO program displays the information in the ^MAIL file.

Micro-MUMPS 4.0 requires 128K RAM and operates on PC-DOS 1.1 or 2.0 (specify when ordering). The list price is $55, payable to Regents of the University of California. To order, contact Richard F. Walters, Ph.D., Division of Computer Sciences, University of California, Davis, CA 95616, (916) 752-7004. ■

Duncan Pringle works as a computer analyst for the Medical University of South Carolina, in Charleston.

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Going By The Board

The life of a bulletin board system operator can be a hard one—remote access requires time, work, money. But being a good "sysop" can also be very rewarding.

Every morning at about 5:30, Rich Schinnell pads downstairs to his kitchen, grabs a mug of coffee, and heads for his computer command center to check the hard copy log his bulletin board system generated during the night. The printout will tell him who called his computer, when, and what they did while their machines were connected to his. It will also include messages, problems, pleas for help, and, all too rarely, appreciative notes from callers all over the continent.

"I like to know what's going on," Rich says of his morning ritual. "That's part of the fun of being a sysop, and it's why I leave the telephone bell on whenever I'm home and not asleep."

A "sysop" is the system operator, the person responsible for offering, maintaining, and paying for a computer bulletin board system (BBS). These systems—there are perhaps 600 to 1,000 or more of them scattered across North America—are accessible to anyone with a communications-equipped personal computer, a telephone, and a modem. And all it takes to start one is a 128K system with one double-sided disk drive, a communications (RS-232) port, a modem capable of automatically answering the phone, and a bulletin board program to make everything work. A number of commercial remote access software products are available, but the Washington, DC,

Capital PC Users Group offers RBBS-PC, a public domain program, for $6, plus $25 membership fee. (For information, contact Capital PC Software Exchange, P.O. Box 6128, Silver Spring, MD 20906. Ask for disk 18.) This is a good program if you're just starting.

Each bulletin board system is effectively a mini-database similar to such commercial enterprises as The Source and CompuServe. Once you sign on, you may find text files and public domain software to download onto your PC, an electronic mail-like message exchange, computer games to play, programs to run, and more. It all depends upon the sysop and what he or she wants to "put up on the board."

Other Applications

While becoming a full-fledged sysop of a major BBS such as Schinnell's may be the ultimate achievement in remote access, it is far from the only application of BBS software. In fact, it seems likely that as the number of PC users continues to grow and as more people find out how easy it is to make their systems available for remote access, the number of applications will mushroom. For example:

- A college professor could set up a remote access system for computer-using students. Reading lists, lecture notes, sample test questions, and a variety of other text file information could be stored on the system for 24-hour retrieval. Messages and questions could also be exchanged among students, with the professor serving as sysop.
- A corporation could equip each field office with a remote access system and use it as a means of exchanging electronic mail. Customers could be given appropriate phone numbers and passwords that would allow them to access the same systems for the firm's latest price list and product information.
- Community groups and clubs could establish central clearinghouses for information either for the community as a whole or just for club members.

The possibilities are endless. It will be several years before enough machines are manufactured and installed to make these applications common and it will probably

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take even longer before dialing a computer becomes as natural to most people as picking up the phone. But the convenience of getting information whenever it's needed and of sending and receiving messages without playing "telephone tag" make the widespread use of remote access personal computers all but inevitable.

Certainly one of the first applications will be among executives who want to access and run from home, files and programs stored in their desktop computers. The PC*jr* already allows you to run many of the same programs and read the same disks used by your IBM PC or XT et the office. But what if you sit down at your home PC*jr* only to find that you left an important piece of information stored on your hard disk at the office? If you booted a remote access program on your office PC and switched on your modem before leaving for the day, retrieving the information would be a simple matter of dialing the phone and signing on from home. Once you're connected, you could run your office system from your PC*jr* just as if you were sitting at your desk.

Evolution of a Sysop

In fact, it was Rich Schinnell's desire to use his office computers from home that originally sparked his interest in remote communications.

It's been quite a few years since Schinnell retired from the Navy to become a defense contractor, and only a few less since he traded in his new Corvette for one of the first PCs to roll out of IBM's Boca Raton, Florida plant. During that time he has built his Rockville, Maryland, bulletin board system into one of the leading IBM PC BBSs in the country.

"Gene Plantz's system in Chicago and mine have been called 'the General Motors and Ford of PC bulletin boards,' " he says. "But I never planned it that way. I had some pretty fair computer experience in the Navy—I taught myself just enough to be dangerous—but I got into this thing mainly because I wanted to be able to access the computers I used at work from

my home." That was the fall of 1981. After his initial purchase, Schinnell bought modems, monitors, memory boards, the IBM Expansion Chassis, a 10-megabyte hard disk, and assorted single-

"Altogether I suppose I've spent something like $12,000 on the machines and remodelling," Schinnell says.

and double-sided floppy drives. He installed a second phone line and modified and rewired a spare room in his house to accommodate all the equipment. "Altogether I suppose I've spent something like $12,000 on the machines and remodelling," Schinnell says. "I really haven't kept close track of things."

He got the idea of setting up an IBM PC bulletin board after attending the first meeting of the Washington, D.C., Capital PC Users Group. About 30 people were there, one of whom was Don Withrow, another pioneer in the field. "I think Don and I got into a little bet about writing a BBS program for the PC. There was absolutely nothing available for the IBM at the time," says Schinnell.

"In fact, the only bulletin board we had in the area was another system operator named Wes Merchant, and it was running on a TRS-80. I went over and looked at his program. Then I read Andrew Fluegelman's *PC-TALK*. Ideas began to occur to me, and I started to make modifications to that program. Meanwhile, Don started writing a program called *Hostcomm*.

"But he couldn't test it with a single system, so he gave me a copy. And of course I bastardized it in about 2 hours, adding the features that I wanted. *Hostcomm* continued to develop and is now a full-fledged BBS package produced by

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Putting in Time

Rich conservatively estimates that he spends about 2 hours a day maintaining his bulletin board. Other sysops, particularly those offering extensive message exchange systems, may spend more time. But whatever the nature of the system, the work is endless. One always has files to delete, usually a library of downloadable public domain programs to update, general system maintenance chores, queries to answer, and often a daily harvest of messages to read. The 30 to 40 callers who log on to a popular system each day can keep a dedicated sysop very busy.

And sysops *are* dedicated. Dedication is part of the official job description. No private individual would spend the kind of time and money a BBS sysop usually invests without a bottomless well of dedication and a heartfelt desire to help fellow computer users. Not to mention devoting a PC full-time to the task.

"Time requirements are something most would-be BBS operators overlook," Schinnell says. "Wouldn't it be wonderful to be a sysop,' they think, and it is! It's very satisfying. But if you're going to do it, I think you should do it right. A lot of people put a board up, but after about a month they find out what they have to do to maintain it, and they close down."

Schinnell also advises prospective sysops to avoid using their regular home phones for the system.

"Once your phone number gets out, people will call you at all hours of the day and night, regardless of what hours you've specified."

If Schinnell had it to do over again, would he still become a sysop? "Absolutely." he says. "It's a lot of work, and it has it's share of headaches. But being a sysop is also a lot of fun. I wouldn't recommend it to everyone, but I personally have found it very rewarding." ■

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Some software is merely licensed, not sold, and you may not actually own it even though you paid for it. The biggest question is, will the courts maintain this distinction?

I received a gift from my father this Christmas—a new program for my IBM PC. After removing the holiday gift wrapping, I held in my hand a box presumably containing the program diskette and user manual, which was tightly shrink wrapped in plastic. Visible through the plastic on the front and back of the box was an imposing notice, the IBM program license agreement (see Figure 1).

The text of the agreement stated that the program may be used, copied, or modified only for use on a single machine. The license may be transferred only if the receiving party agrees to abide by the terms of the license. IBM prohibits all sublicensing and other transfer arrangements. It claims the license exists in perpetuity, unless you violate its terms or destroy all of your copies of the program. The program is supplied "as is," and the warranty covers only the diskette or cassette itself, not any program it may contain. Opening the program by destroying the shrink wrap is considered an acknowledgement of having read, understood, and agreed to the license's terms and conditions. Does this mean anything? Do people realize that they are paying for a license to use a program rather than for the program itself?

I asked this question of a number of prospective software buyers at a local software store and also of a number of lawyers. With a few exceptions, the prospective purchasers were under the impression that they were purchasing a program, not acquiring a license to use that program under specific conditions. On the other hand, the lawyers all acknowledged that the program is technically licensed, but disagreed on whether a court would ultimately let this distinction stand.

ILLUSTRATION: Marc Taffet

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The lawyers were divided on how the courts would deal with this issue, because there has been very little litigation pertaining to the difference in rights between the owner of a copyright in a computer program and the owner of a copy. Most similar court cases have involved the entertainment industry. These cases emphasized that the copyright laws give the owner of the copyright an exclusive right to control how the copyrighted work is to be used, but once a copy is sold, the copyright owner loses control over that particular copy. This is known as the "first sale

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Figure 1: *The IBM Program License Agreement.*

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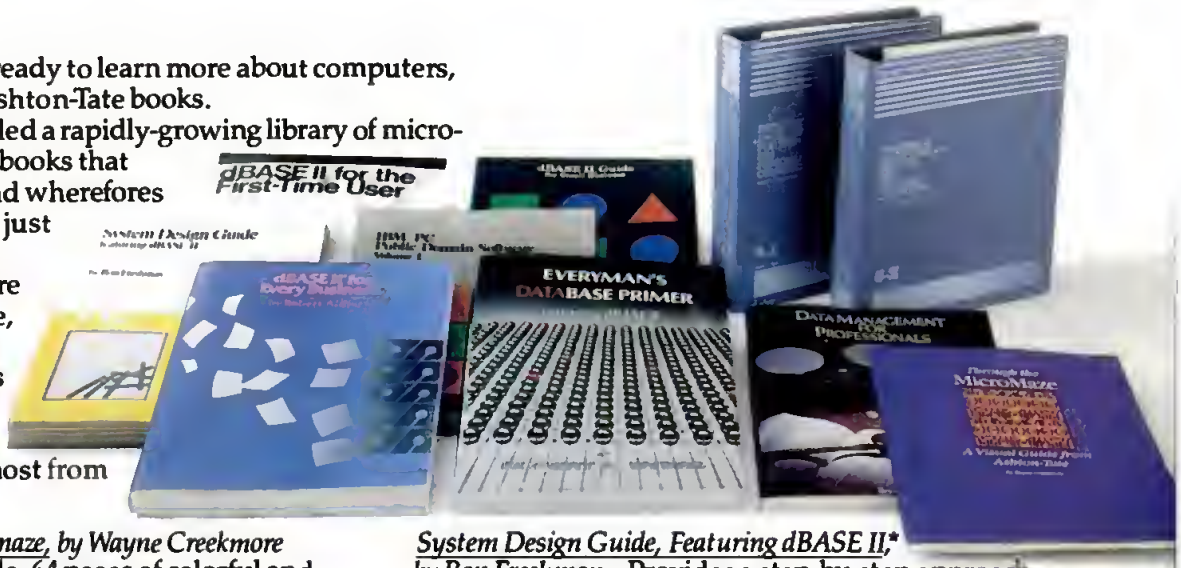

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doctrine."

What difference does all this make? Quite a bit. If IBM sold the program to my father, then he, and now I, own the copy. Under the first sale doctrine, IBM has no right to tell me how to use the program. I cannot make an unauthorized copy, since IBM owns the copyright, but I should be able to use the program with as many computers as I want. Since I own the copy, I should also be able to sell it, give it away, or do anything else not reserved to a copyright owner. But if IBM merely licenses the program, it still owns the copy, and I have only a nonexclusive right to use the program. My right is subject to IBM's conditions. In other words, although I have a rightful possession of the program, IBM retains title to it.

As a practical matter, it's important to IBM, as well as to other software producers, that they be allowed to license their software instead of sell it. Otherwise, soon after the initial sale of a relatively few copies of a program, the market could be flooded with unofficial copies, which would seriously reduce sales. Although software producers could copy protect their programs, there are ways to circumvent this.

Licensing custom software to a single or limited number of users is probably valid, because the opportunity for true negotiation exists between the supplier and each end user. Both parties can discuss the price and conditions under which the program is to be used; the user can be informed of exactly what he is paying for before the deal is carried out.

However, this is not so in the mass market. Most persons who hand money to a cashier in a software store (or send a check or credit card number to a mail-order house) believe that they are purchasing, not licensing, the program, regardless of what the vendor calls the transaction.

The Other Side

This argument is used by opponents of the shrink-wrap approach to mass-market program licensing. Any transaction (sale

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ISSUES

or license) is just what it appears to be; calling a sale a license does not make it one. These opponents point out that the typical software transaction has all the characteristics of a sale. The user takes the program off the shelf (or makes a mail-order selection), provides a one-time payment, and therefore owns the program forever. He or she probably does not read the licensing notice on the box and, even if he does, he does not really think about it. He probably throws the box containing the notice, together with any warranty information, into the trash. Furthermore, the user never signs anything.

Supporters of shrink-wrap licensing reply that by merely tearing open the plastic wrapping, the user has acknowledged that the program is being licensed rather than sold, and has agreed to all the terms. After all, the argument goes, look at the language in the IBM notice. If you do not accept the terms and conditions, or do not agree with them, you can just return the package unopened to receive a refund.

The problem does not lie with the lack of signatures by the supplier and user. The law often considers terms of agreements to be accepted by the conduct of the parties, rather than by signatures. For example, when you drop off your laundry at the cleaners, you have a legal obligation to pay for the work after it has been completed, and you are bound by the conditions written on your laundry ticket, even though you didn't sign it. The act of tearing open the shrink wrap on the program is considered an affirmative act, which is equivalent to an acceptance of the terms and conditions written in the notice.

It's still unclear how the courts will rule on this issue. In early circuit court cases involving the motion-picture industry, the courts have tended to treat the transfer of films as licenses, rather than sales, even where very few restrictions were placed on use of the films by the producer. Bear in mind, however, that those cases did not involve mass marketing. The licensing of mass-market software remains a wide-open question. ■

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How the four major COBOL compilers comply. A feature-by-feature comparison of compilers from Microsoft, Micro Focus, Ryan-McFarland, and mbp to the ANS COBOL X3.23-1978 standard.

Trace 86 and Code 86
Two assembly language program debuggers reviewed.

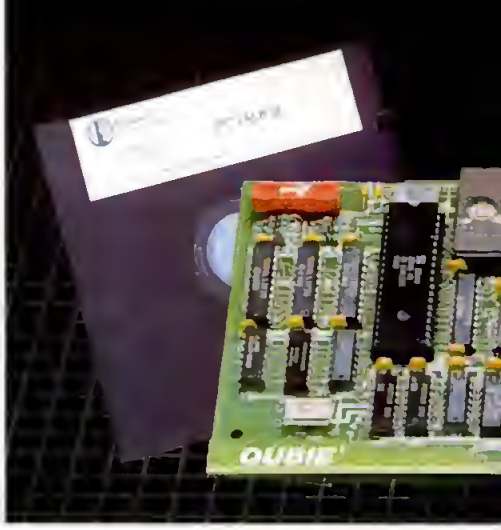
High Resolution Timing on the PC
Same techniques for obtaining timing information with microsecond resolution on the PC.

LISP for the PC
A specialized language implemented on large minis and mainframes to satisfy the research needs of the growing artificial intelligence community has come to the IBM Personal Computer. PC Tech Journal provides an in-depth look at some versions of the language now available, including the IQLISP, TLC-LISP, and muLISP.

Sorting Methods and Timing for the PC
The implementation and performance of eight sorting algorithms for the PC.

Routines for Controlling Sounds on the PC
An excerpt on sounds from the Waite Group's *Bluebook of Assembly Routines* for the IBM PC, with program listings for producing various sounds, including a routine to play music.

Tale of Two Mice
Microsoft's mechanical mouse and Mouse Systems' optical mouse: How they fare in the electronic maze.



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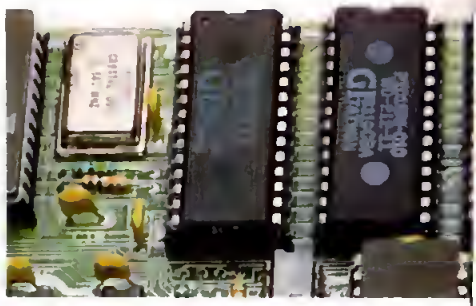

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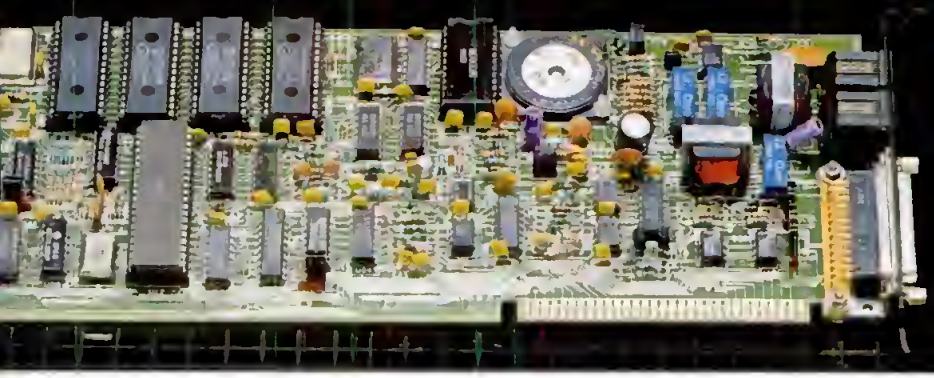

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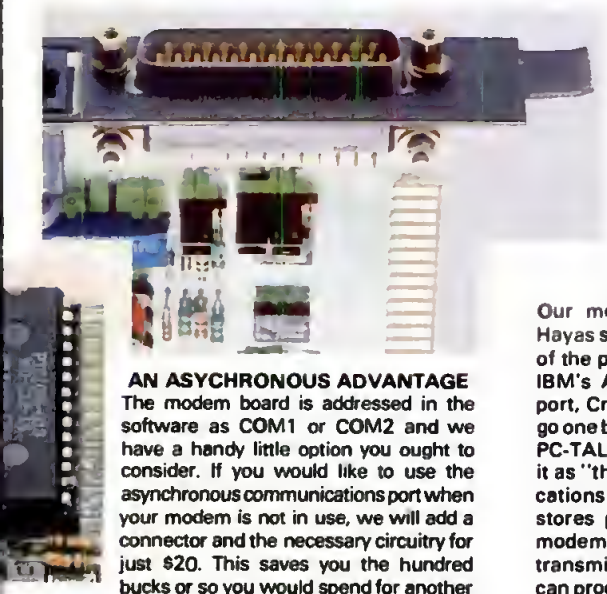

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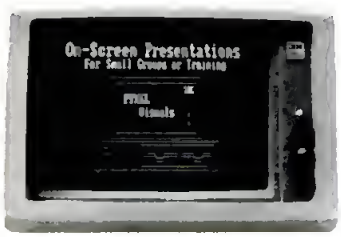

The SHOWTIME utility, included with PYXEL Visuals, lets you link screens together and create a free-running show. You choose the time between screen changes. Or use prompt mode to step forward to each screen or go back to a previous screen.

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CIRCLE 382 ON READER SERVICE CARD

Coming Up

Compatibles Roundup

Do the so-called PC compatibles relate to the IBM PC as well as they claim? We'll gather some of the compatibles on the market—including the Compaq, Docutel/Olivetti, Eagle Computer—and test their bidirectional compatibility. We'll examine hardware and software, as well as operating systems and their utilities, expansion compatibility, testing and timing processors, disk drives, and monitors.

PCs in Pinstripes

IBM's dream is to have a PC on every desk in America. Some of the country's largest companies are taking the plunge. What kinds of special problems and benefits are these corporate giants facing? Paul Somerson tells you all about it.

PC Rocker

Rock star Roger Powell has put his successful career as keyboard player for the pop group Utopia on hold. Now he's turning his talents toward creating an IBM PC configuration capable of creating any musical sound imaginable. *PC* will explore how.

PC and the Artists' Agent

Artists' representative Randy Winter's many clients include Gahan Wilson, one of America's best known cartoonists. We'll explore how Winter uses his PC to keep track of his creative clients, and take a look at software he's developing.

A Better Printer

PC reports on Texas Instruments' new 855 printer. This compact piece of hardware not only produces both draft and high-quality dot matrix print, it also allows users to doublespace, change character spacing, and play with typestyles using removable cartridges—at a price below that of many of its competitors. We'll take a look at how it performs.

Lowdown on Modula-2

Heralded by some as *the* language of the eighties, Modula-2 fulfills the potential of its forerunner, Pascal. Correcting many of Pascal's flaws and improving Pascal's performance, Modula-2 brings Pascal into the business world. In this special report, *PC* explores modular compilers, chronicles the history of Modula-2, visits with Modula-2 inventor, Niklaus K. Wirth, and compares the two languages.

Peering at WordVision

A new word processing package from Bruce and James Program Publishers, Inc., *WordVision* is easy-to-use, fast, and very inexpensive. We'll look at how the program stacks up against software costing five times as much.

Managerial PCs

The introduction of PCs into corporations is having a profound impact on middle management in American companies. This report explores how microcomputers have transformed the way managers go about their business and how they're judged by the corporation.

Telex and the PC

If you want to send a telex to Europe, you won't have to travel any farther than your PC.

Columns

Two of *PC*'s columns will have MUMPS next month. MUMPS, a programming language originally developed for medical applications, has now gained wider usage. *PC* will examine MUMPS as a programming language, as well as its hospital and general applications. Our education column looks at the move to interactive training tools, while the writing column dissects the PC-typesetting connection. Watch for these and other columns by professionals in a variety of fields. They should prove useful and informative.

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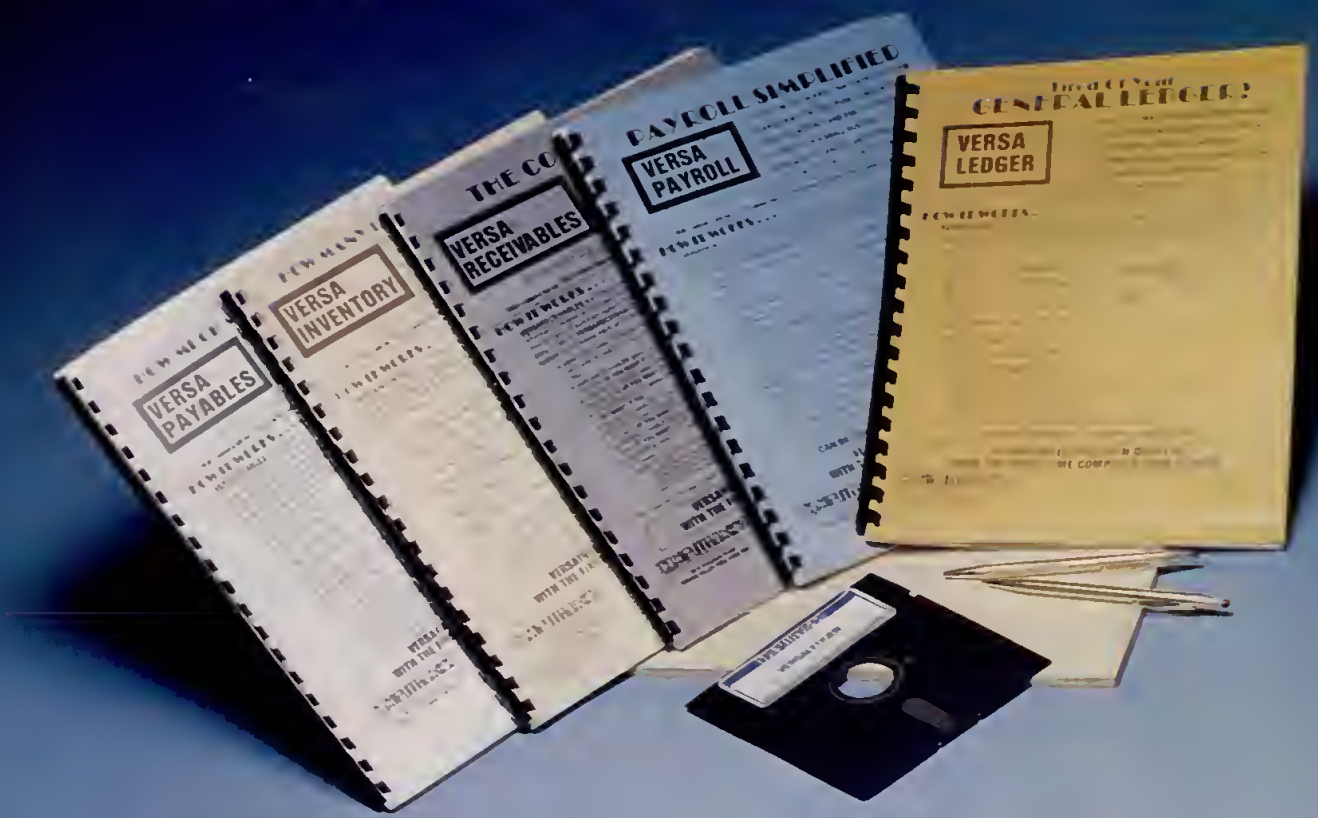

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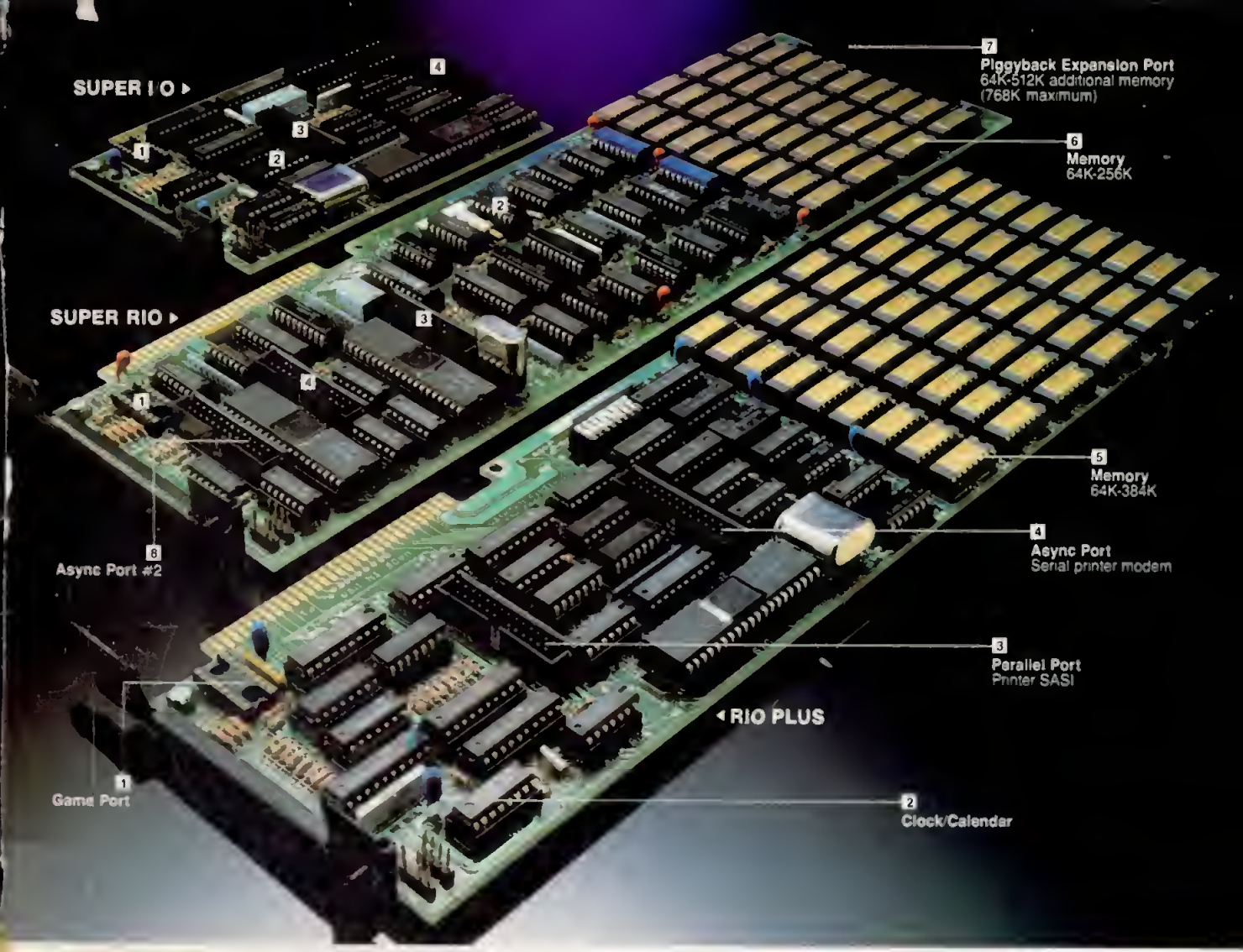

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The Executive

The EXECUTIVE is the most complete implementation of ELAN, adding computer recognition of spoken commands. An executive might phone the PC to leave or retrieve messages or request specific information. The PC, in a spoken voice, can request a user's access code or prompt the user for a command. The executive can respond either by pushing buttons on the telephone, or by actually speaking back to the computer.

The SECRETARY is the basic ELAN system. It includes an Ethernet interface and all other ELAN features except modem and voice recognition.

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The Secretary

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